SCIENCE LIBRARY

APR 16 1927

April 16, 1927

McGRAW-HILL PUBLISHING COMPANY, INC. TWENTY-FIVE CENTS PER COPY

ENGINEERING AND MINING JOURNAL

A Consolidation of Engineering and Mining Journal and Mining and Scientific Press

METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

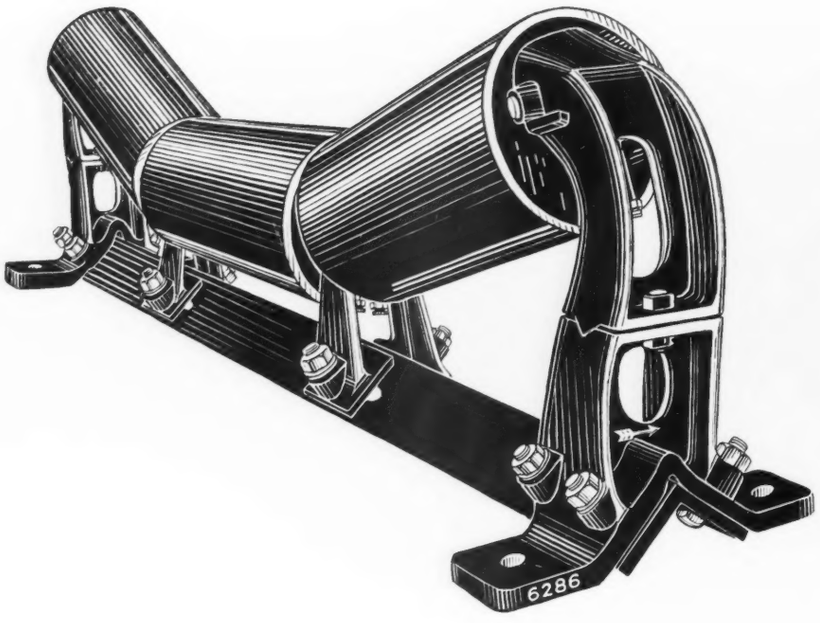
Scraper Loaders, as Designed and Used at Casapalca, Peru, by C. S. T. Farish and J. C. Pratt

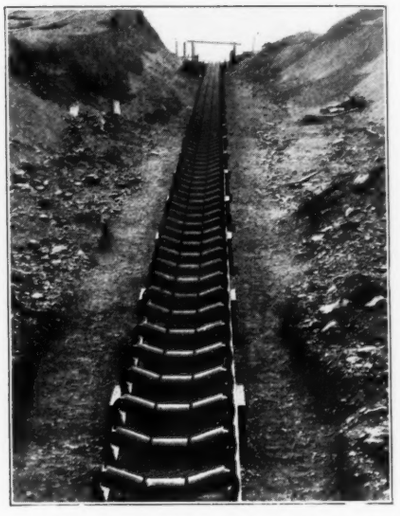
Hoist Control in Northern Ontario, by A. Brian

On Ore Magmas, by J. H. L. Vogt

The State Geological Survey as a Service Feature of State Governments, by Wilbur A. Nelson

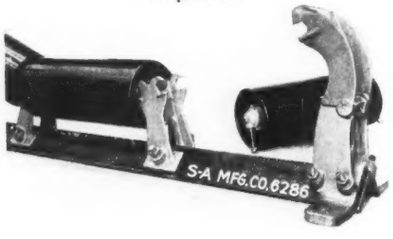
"Why conveyor belts last longer"

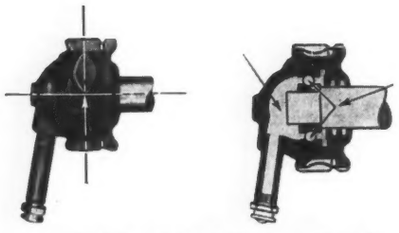




Conveyor shown before Belt was installed

Outer brackets are hinged, roller and bearings are easily removed for inspection





The cut above at the left shows the balanced suspension of oscillating housing. Cut at the right shows radial and thrust loads carried on ball bearings and grease cavity with multiple grease seal.

BELTS used for large belt conveyors are costly equipment and anything that will lengthen their service life receives the careful attention of engineers.

Carriers used in constructing belt conveyors have much to do with the length of service received from belts. Stephens-Adamson engineers are expert in designing carriers that will be easy on belts, and the Sacon Carrier shown herewith is just one example of their skill.

The S-A Sacon Carrier represents the best results attainable in eliminating friction, etc.

STEPHENS-ADAMSON MFG. CO.

Factories: Aurora, Illinois, and Los Angeles, California

Branch Offices in all Principal Cities

STEPHENS-ADAMSON

S-A BELT CONVEYORS

Volume 123 New York, April 16, 1927 *Number* 16

ENGINEERING AND MINING JOURNAL

J. E. SPURR, Editor

GEORGE J. YOUNG, Associate Editor, San Francisco, Calif. T. A. RICKARD, Contributing Editor, San Francisco, Calif.
A. H. HUBBELL, Managing Editor
E. H. ROBIE, A. B. PARSONS, W. N. P. REED, E. J. GEALY, Assistant Editors
Tenth Ave. at 36th St., New York, N. Y.
883 Mission St., San Francisco, Calif. Colorado Building, Washington, D. C.

Contents

*Illustrated Article

Editorials 633

Mr. Spurr Resigns
Lower Commodity Prices
Gold Mining and the Lowered Price Index
Opportunity and Africa
Personal Experience With Doodle Bug
Mining Terms
Fixed Epithets in Mining
Rice and Associates

***Scraper Loaders, as Designed and Used at Casapalca, Peru** 636
By C. S. T. Farish and J. C. Pratt

***Practical Economic Value of the Service of a State Geological Survey** 640
By Wilbur A. Nelson

***Hoist Control in Northern Ontario** 643
By A. Brian

On Ore Magmas—I 645
By J. H. L. Vogt

Useful Operating Ideas 651
*Scraper for Conveyor Pulley
By Charles Labbe
Experiments With Dust Catching Devices
*Emergency Drive for Mine Fans
*Drill-Steel Car for Tunnel Work
Heavy Liquids for Mineralogical Analyses
*Estimation of Thermal Expansion
By W. F. Schaphorst

Consultation 653
Guggenheim Nitrate Process
Market for Kyanite and Dumortierite
Pyrites Quotations

Mining News 655
Canada Maps Mining Areas by Airplane
New Work in Michigan Copper Field Encouraging
Mohave County Complex Ore Production Increases
Preliminary Work at Fairbanks to Start Soon
Atlas Completes 7,000 Ft. Tunnel

Societies, Addresses and Reports 662
American Metal Employees Celebrate Twenty-fifth Anniversary of Chrome Plant

Men You Should Know About 664

Obituaries 664

New Machinery 665

Market and Financial News 666

Metal Price Curves 667

Review of Current Statistics 668
By A. B. Parsons

E. & M. J. Statistics of the Mining Industries 669

Market Report 670

Mining Stocks 672

Professional Directory 43-45
Searchlight Section 47-49

What and Where to Buy 50-52
Advertising Index 54

McGRAW-HILL COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

JAMES H. McGRAW, President
JAMES H. McGRAW, Jr., Vice-Pres. and Treas.
MALCOLM MUIR, Vice-President
EDWARD J. MEHREN, Vice-President
MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President
C. H. THOMPSON, Secretary

WASHINGTON, Colorado Building
CHICAGO, 7 S. Dearborn Street
PHILADELPHIA, 1600 Arch Street
CLEVELAND, Guardian Building
ST. LOUIS, Bell Telephone Building
SAN FRANCISCO, 883 Mission Street
LONDON, 6 Bouverie St., London, E. C. 4

Cable Address: "Machinist, N. Y."
Copyright 1927
By McGraw-Hill Publishing Company, Inc.
Publishers of
Engineering News-Record American Machinist
Power Chemical and Metallurgical Engineering
Coal Age Engineering and Mining Journal
Ingeniería Internacional
Electrical World Electrical Merchandising
Bus Transportation Electric Railway Journal
Industrial Engineer Radio Retailing
Successful Construction Methods
Electrical West
(Published in San Francisco)
American Machinist—European Edition
(Published in London)

The annual subscription rate in the United States, Canada, Mexico, Alaska, Hawaii, Philippines, Porto Rico, Canal Zone, Honduras, Cuba, Nicaragua, Peru, Colombia, Bolivia, Dominican Republic, Panama, El Salvador, Argentina, Brazil, Spain, Uruguay, Costa Rica, Ecuador, Guatemala, Chili, Haiti and Paraguay, $5 per year. Extra foreign postage, $3 (total $8 or 34 shillings). Single copy, 25c. Change of Address—When change of address is ordered the new and the old address must be given. Notice must be received at New York at least ten days before the change takes place. Published weekly. Entered as second-class matter June 20, 1879, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.
Member Audit Bureau of Circulations.
Member Associated Business Papers, Inc.

11,878 COPIES PRINTED THIS ISSUE

HOAR SHOVELS

Some reasons for Hoar Shovel superiority

A practical design, conceived by a practical miner, and developed in actual mining conditions.

Ten years of application in all classes of mine and tunnel work, with constant improvement, as conditions indicated.

Simple air motors, direct-connected to each operating unit, give positive, independent control of all movements.

Design follows closely that of larger power shovels, with direct crowd, powerful hoist, and full revolving feature.

Sturdy construction,—liberal use of cast steel, alloy steel shafting, and hardened gears, insure uninterrupted service, long life, and minimum upkeep.

Large loading capacity means profitable operation—lowered costs and increased speed.

Built by one of the oldest and largest mining machinery manufacturers to the same standards that have made the name Allis-Chalmers so well and favorably known in the mining field.

Investigate Hoar Shovels as a means of reducing your mucking costs—
Write for Bulletin No. 1824

ALLIS-CHALMERS

MILWAUKEE, WIS. U. S. A.

ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

Volume 123 | New York, April 16, 1927 | *Number* 16

Mr. Spurr Resigns

ELSEWHERE IN THIS ISSUE the publishers announce the resignation of J. E. Spurr as editor of *Engineering and Mining Journal.*

Mr. Spurr's going will bring regret to the readers as it does to the publishers. For eight years he has carried on the editorial work of the *E. & M. J.* with an eye single to the interests of the readers. He has improved the paper in all its departments, so that today it enjoys the highest reputation in its distinguished career.

Fortunately, he leaves a well-trained staff to carry on and maintain the high standards he has established. Most of this staff has been with him for his entire editorship and has aided him in the making of the *Journal* as it is today. That is warrant—in addition to the pledge of the publishers—that the ethics of the *E. & M. J.'s* service will be jealously maintained and the character of matter presented steadily improved.

But while Mr. Spurr's hand is seen in every part of the paper, it is most conspicuous in the editorials. Here he has been at his best. These pages have truly been he. There has been wisdom, searching penetration, frank praise and criticism, and an indulgent smile at foibles.

He has the faculty of seeing the essence of problems. He has a refreshing intolerance of cant, hypocrisy, and wrongdoing. His intolerance of unsoundness has at times led him into what some would regard as undiplomatic expression. But it was all of a piece with the man; his convictions impel him to declare where he stands. He has served the *Journal* and its readers well.

We regret his going and wish him Godspeed.

THE PUBLISHERS.

Lower Commodity Prices

TRENDS IN PRICE, production, consumption, and similar factors may take place so gradually that they are accepted as a matter of course and often escape specific mention unless perhaps they happen to pass certain numerical milestones. What might be considered such a milestone has just been passed by the general commodity price index compiled by the Harvard Economic Service. In the week ended March 26, the index, which is based on the wholesale prices of 48 important commodities, declined below 140, the average for 1913 being taken as 100. The actual figure for the week was 138.4, which is lower than the low point reached in 1924, and comparable with yearly averages as follows:

1913	100	1920	226
1914	98	1921	147
1915	101	1922	149
1916	127	1923	154
1917	177	1924	150
1918	194	1925	159
1919	206	1926	151

The current decline, which has persisted now since the summer of 1925, is attributed to monetary readjustments and industrial depression in European countries; there are no indications that prices will continue to decline until they get back to pre-war levels. This still seems only an indistinct possibility for the future. The chief declines have been in the prices of raw materials which make up the bulk of America's export trade: petroleum and its derivatives, non-ferrous metals, corn and wheat, hogs, hides, and cotton.

It will be a satisfaction to producers of copper, lead, zinc and silver to know that the lower price trend is not confined to non-ferrous metals, but is a general tendency, and should thus result in lower costs to offset, in part at least, the lower prices received. For those who would like to see the indices turning upward, it might be said that an improving European trade would do much to bring this about, and such improvement is not unexpected.

Gold Mining and the Lowered Price Index

IN FURTHER COMMENT upon the tendency for commodity prices to decline, it may be recalled that each important war in the history of the United States has been marked by high prices, which in the course of time became gradually lowered. The inflation, and the amount of time necessary for deflation, have proved to be in proportion to the severity and length of the conflict. The Mexican War (1840-41) was marked by an inflation to a price average (commodity index) of 102½; the Civil War resulted in an average inflation to a figure of 133, during the fourteen years 1862-76 that the inflation lasted—till ten years after the war's close; the twelve years of the Great War and thereafter, from 1915 through 1926, resulted in an average of 162, with which we can compare the present figure of around 140, as cited in the preceding editorial. This is still an inflated figure: as European finances become more and more stabilized on a gold basis, this index figure will fall, a process which may well occupy five or ten years more.

This has an important bearing on gold mining. J. E. Spurr, in an article on "The World's Gold," in *Foreign Affairs,* April, 1925, summed up the situation thus: "The world supply and consumption of commodities relative to the available gold have decreased since pre-war times, and this is one of the chief factors why commodities are still high in price. If average peace and prosperity abide with the world in the next few decades, we can foresee a great increase in the production and consumption of commodities in general; but for gold, as above stated, we cannot see any commensurate increase. The indications are that the production trends of gold and of commodities in general will become more and more divergent as time flies, and it is very possible that the world will never again see so large a production of gold relative to the

production of other commodities as marked the period from 1898 to 1915. In the long run, therefore, the world commodity price index should tend to sag. As it does so, the cost of gold mining will be lessened, and this will tend to increase gold mining and production, and thus offset the secular decline. Another offset to this secular decline will be constantly greater efficiency and economy in operating mines. These checks will flatten out the general declining tendency; but they cannot obviate the progressive exhaustion of gold mines, while the increase of general commodity production will rise without any visible limit."

The practical application of this is that the outlook for gold mining is good and will be increasingly so. Costs should tend to decrease: and wherever there is any large deposit which affords a supply of ore for many years, which can barely be worked at a profit at the present time, the outlook is that it may be gradually transformed into a well-paying business.

Opportunity and Africa

AFRICA ought to be a land of opportunity for those who follow mining, especially for those who are already on the spot. But the opinion has been heard that the interests who have secured concessions in the regions now in the limelight may have difficulty in getting men. The wild, unsettled country, the climate, and the pioneer conditions might account for this in part. But most mining men are schooled to expect a rough existence. There seems to be another reason: Unlike the American West, where the man whose only capital was his ability and willingness to work nevertheless had the chance to make a fortune, and unlike the Canadian provinces, where the same chance may be found today, the new mining regions of the Dark Continent hold out their promise principally to capital that is able to secure concessions. For the individual, minus capital and influence, there simply seems to be a "job."

This being so, difficulty may well be had in getting men—the right men. The engineer cannot be expected to bury himself alive for what is merely ordinary compensation. An interest in the enterprise, even though a limited one, would act as an incentive.

Personal Experience With Doodle Bug

Gus Wisner writes from Gold Creek, Mont., as follows:

"Sir: In your *Journal* of March 19, 1927, at the close of your editorial on the first page, you say 'Upon the fringes of the systematic work are various quacks, doodle-bugs, and forked-twig experts. These impress the unwary and slightly fog the atmosphere.' I take it for granted that you would not thus condemn the doodle-bug expert without some knowledge of the instrument he uses. Will you have the kindness to tell the readers of the *Journal* what your experience has been with it personally and what you saw of its workings in the hands of others, with a brief description of the bug and the principles on which it works? Please answer through the columns of the *Journal*."

A mandate is mandatory; and since the editor passed away as editor the day before the date of this issue, the desired testimony will be a sort of posthumous communication, much sought after by students of the occult—and the Divining Rod belongs to that realm.

As for experience, we (meaning always I) will give briefly our most impressive one, unfortunately greatly condensed—the rest omitted through lack of space, as we sometimes explain when rejecting manuscripts.

It was perhaps in June, a number of years ago, that at the request of certain moneyed interests, and as an "expert," we visited the city of Wilmington to observe the workings of what has been irreverently called a doodle bug. The escorting committee was large and influential, comprising, besides representatives of the aforesaid interests, attorneys, real-estate men, and some of the first citizens of Wilmington. We first proceeded to the house of the owner and operator of the instrument. This operator proved to be a gentleman of wealth and education, deeply interested and enthusiastic concerning the instrument; and suspicious of, and even, evidently, hostile to, engineers, who he said would naturally be prejudiced against it, since it would put them all out of work. He declared with feeling that he had located valuable metal deposits in the vicinity of Wilmington, as he would demonstrate. The instrument he had bought from the inventor, under contract not to allow examination by anyone; but he consented to show that there were two handles arranged like those of a draw-shave, with a metal box between. If you were prospecting for gold you put a strip of gold in the metal box; if for lead, of lead, and so on; and the instrument would turn down despite muscular effort to hold it horizontal if ore carrying the particular metal tuned in for were passed over. He had even located gold in his back yard. To prove it he showed assays; and as further proof produced washings in a gold pan. Examining this, we were surprised to actually find gold in the tail of the washings. Inspecting the gold with a lens, the further fact appeared that the particles were not water worn, nor yet ragged: They were spherical pellets. In effect, they were not placer gold, but the tiny beads from assayers' cupels. The assayer (from Philadelphia) was present, and as we raised our head and gazed thoughtfully at him, he winked covertly and trustfully, as who should say "Aren't we brother engineers?"

A veritable procession of dignitaries, we then proceeded to a cow pasture owned by one of the Du Ponts: and the gentleman demonstrated convincingly. "Now," he said, "I'll test for gold." Slipping the gold strip in the instrument, he walked across the field. At a certain point the instrument bent down; nor could all his strength prevent it. This point was marked as one wall of the gold lode, beneath the soil and grass. A little further he was able to regain control of the instrument: that marked the other wall. It can readily be seen that by two traverses the strike of the lode could be ascertained. The gold lode was some 28 ft. wide, and assayed, he said, four dollars to the ton, when the surface soil was tested by the same Philadelphia assayer. Next he demonstrated for nickel. A nickel lode 16 ft. wide, cutting the gold lode at right angles, was demonstrated beyond doubt. Next the test was for petroleum. A tube of petroleum was inserted in the instrument, and a wide lode of petroleum cutting both the other two and running just past the stern of a Jersey cow, was demarked. It was a great pasture. We became a little confused at its varying resources. On request, we tried out the instrument, but it refused to correspond: the owner said he knew it would not—it would only respond to

certain people—he thought it had something to do with the ultra-violet rays.

In the end we were polite and non-committal, as all engineers who value their skin learn to be. We were taken back to Wilmington, and given a fine lunch by a group of selected capitalists: then asked to spill it. In reply, we asked if the operator's watch chain had been observed—it was quite the heaviest gold watch chain we had ever seen, strung across his vest, and close to the instrument as it turned powerfully down over the soil which ran four dollars in gold to the ton. The eager group, hanging on our verdict, had observed it. How was it, we continued, that the instrument was insensitive to gold assaying 1,400 pounds to the ton, while sensitive to one-fifth of an ounce? A feeling of dislike began slowly to emanate from the capitalists; they clearly suspected our honesty; and so we had to face the rest of the day with a feeling of disgrace.

We have had other experiences: but in view of the lack of space——

Mining Terms

MORE OR LESS CONFUSION arises from the use of such mining terms as chute, ore pass, transfer, waste pass, finger chute, finger raise, drawing raise, chute raise, and similar words. In all of these terms the purpose of the structure is restricted to the downward movement of broken ore and waste rock. Two general types are in general use. One is a timber structure which is built up as the stope rises and the other is a winze or raise in rock or solid ore which may or may not be supported by timbers and lined with boards. It is suggested that the term ore pass be restricted to timbered and lined structures which are extended up in a waste-rock fill as the stope is worked upward, and that the term transfer be restricted to the winze or raise in rock or solid ore that is used for handling ore or waste rock. The qualifying terms, inclined transfer, vertical transfer, timbered transfer, waste transfer, timbered waste transfer, are obvious. The term chute should be restricted to the chute gate and its accessory structure. A comparatively short transfer such as would be used in undercut caving could be called a "finger transfer." The term raise should signify a manway with or without the accessory transfer. A manway and accompanying ore pass might well be designated manway ore pass. Similarly a timbered transfer with accessory manway might be designated manway transfer or manway waste transfer. When the term transfer is used without qualifying word, the significance should be an ore transfer.

Fixed Epithets in Mining

TO THE TROUBADOURS of mediæval times and their later imitators knights were "bold" and ladyes "fair" and chiefs in general "crested." So, too, in epic poetry descriptive epithets were too often monotonously unchanging. A trait of human nature it seems to be to give a name and stick to it. Even matter-of-fact reporters of market news show a tendency in this direction. Is there any other name for copper save "the red metal," or for aluminum save "light metal," or for silver save "white metal"? The lack of synonyms cramps the reporter's style. As it is, with his limited means he manages to get in a graceful touch that tends to lessen the crass commercialism of it all. A few more synonyms would be useful.

Rice and Associates

THE Attorney General of the State of New York is engaged in another government offensive against George Graham Rice, this time in an endeavor to stop the sale of the shares of the Columbia Emerald Development Corporation. Besides Rice, his brother-in-law Frank Silva, Ex-Judge Nash Rockwood, Frederick Lewisohn, and Edward J. MacNamara are co-defendants.

The complaint of the Attorney General of the state charges among other things that defendants caused an option to be given to Rice and his associates, for 500,000 shares of the company in question, of which 400,000 were the personal property of the Lewisohn interests, at 75 cents a share: of the proceeds of which, only $100,000 was to be paid into the company's treasury. The complaint further charges that "pursuant to this conspiracy to defraud," the defendants caused the stock of the Columbia Emerald Corporation to be listed on the Boston Curb, and boosted it by "fictitious or 'wash' sales" up to $17 a share in September, 1926. Yet on Feb. 16, 1926, the only assets of the corporation were the mines "appraised at a fictitious value of $250,000," "a spoonful of stones of an inferior quality and unsalable, with the exception of two emeralds," and $60,000 cash, against which was a debt of $51,000 due to one of the defendants, Frederick Lewisohn, from the corporation. The complaint further alleges that the statements used in Rice's paper, the *Iconoclast*, to boost the stock were false and fraudulent, as, for example, "That a Lewisohn syndicate has been formed for controlling the world's emerald market" and that said mines "will produce $100,000,000 of gems." It is alleged by the Attorney General that 235,000 shares were sold to the public at various prices, some as high as $17 a share.

Rice, on his part, is well supplied with legal counsel. They are listed by Rice himself in the May 27, 1926, *Iconoclast:*

"We shall place them (sundry facts) at the disposal of former United States Attorney Henry A. Wise, notably successful as a prosecutor of stock frauds when United States Attorney in the Southern District of New York; Honorable Louis Marshall, America's foremost constitutional lawyer; Hon. Charles S. Whitman, former Governor of New York; and former Judge Nash Rockwood, who are among the attorneys and counsel of the *Iconoclast*. . . ."

This statement is corroborated by the records of the Supreme Court of the State of New York, wherein each of the lawyers named appears as counsel for Rice, and also by Mr. Wise, in reply to a communication from the Editor.

Considering the statement above concerning "former United States Attorney Henry A. Wise, notably successful as a prosecutor of stock frauds when United States Attorney in the Southern District of New York," it is interesting that Wise as District Attorney brought and conducted in 1911 a suit against Rice for alleged illegal stock selling, which resulted in his conviction and sentence to a year's imprisonment. This case was in connection with the charge of using the mails to defraud in promoting the sale of shares of the Ely Central Copper, and running a bucket shop.

The foregoing is a partial statement of published facts, uncolored by editorial opinion.

Scraper Loaders, *as Designed and Used at Casapalca, Peru*

By C. S. T. Farish
and
J. C. Pratt
Assistant Superintendent and Chief Engineer, respectively, Cerro de Pasco Copper Corporation

THE DESIGN OF THE FIRST LOADER made at Casapalca, Peru, was taken from that shown in the *Engineering and Mining Journal* of May 3, 1924, as developed by the Mineral Mining Co., of Iron Mountain, Mich., and called the Osana loader. Of this

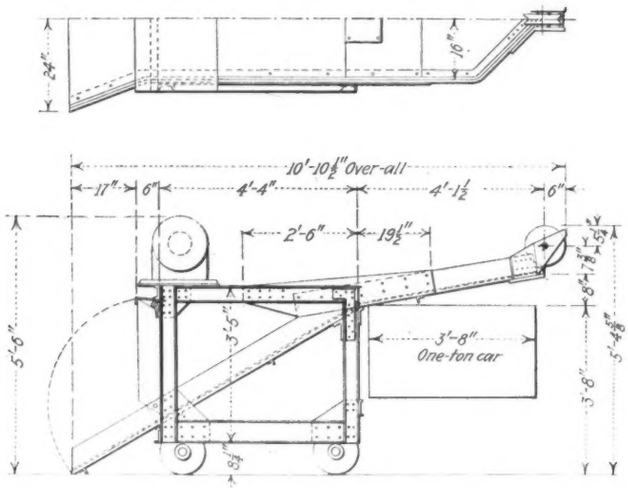


Fig. 1—Sketch of Type A scraper loader developed at Casapalca, Peru

the most important feature was the use of a cantilever boom for the dump, which gave a self-contained unit, as compared with the earlier slides built in several sections and requiring considerable time to set up and dismantle. The Cerro de Pasco Copper Corporation's mining department prepared the plans for this, the first Osana loader in Peru, and, upon its recommendation, the Sociedad Minera Backus y Johnston del Perú obtained and used them.

The loader was put in operation on the 2,100 level of the Carlos Francisco mine in a 7x9-ft. crosscut of some length. As the crosscut was straight, the large size of the loader did not cause much difficulty, but when the vein was encountered, with its twists and turns, even though the same section of heading was used, the loader became very awkward to handle. Moreover, the box-type scraper with saw teeth and a square yoke across the front was not suitable for the rock, which was often coarse. On the whole, the loader was not a success in work on the vein.

Improvements on Loader

However, the possibilities were recognized, and R. M. Sánchez, the former engineer, designed a second loader for use in a new tunnel, the cross-section of which was to be about 8x9 ft., with a large ditch on the side. In principle, the loader was the same as the first one, with the following changes: The frame was made square in section, which raised the position of the hoist considerably, but still kept it below the height of the rear sheave. The over-all dimensions were reduced on all sides. Instead of a sharp break in the slide, an arc of 9-ft. radius was used. (It was found that even with this arc the bottom plate of the slide was worn quickly by the rope, so a half-inch reinforcing plate was put over this part, and changed as needed.) Six-inch channels were used for the sides of the slide, with the flanges inside so that the channels could be riveted to the frame. It may be noted here that the flanges caused the scraper to catch sometimes, which led to the use of angles in their place on the later designs.

This second loader was designed for use with a 1½-ton car of the dimensions given in Table I. A box-type

Table I—Comparison of Sizes of Loaders

	Over-all Length, Ft.	In.	Width of Frame, Ft.	In.	Width of Slide, Ft.	In.	Maximum Height, Ft.	In.	Width of Lip, Ft.	In.	Size of Car Used, Tons
Original Osana	17	0	4	0	3	7	6	0	5	6	1½
Second loader	14	10	3	8	3	3	5	8	4	6	.....
Type D loader	12	5	3	0	2	8	5	11	4	0	1½ and 2½
Type A loader	10	10½	3	0	2	8	5	6	4	0	1

scraper was first used, but this was later replaced by one of the hoe type, which has since been changed repeatedly in design until a satisfactory one has been developed. This loader gave excellent results in the tunnel until it wore out, but it was considered too large for use in small headings.

Loader for Universal Use Sought

Since by this time the feasibility of the Osana loader had been thoroughly proved, all that remained was to develop one suitable for use in all places. Immediate requirements called for a small loader for use with a 1-ton car in old workings that were narrow and tortuous. The Type A loader was designed to meet this need, which it has done satisfactorily. At present, however, our most important workings are those using gable-

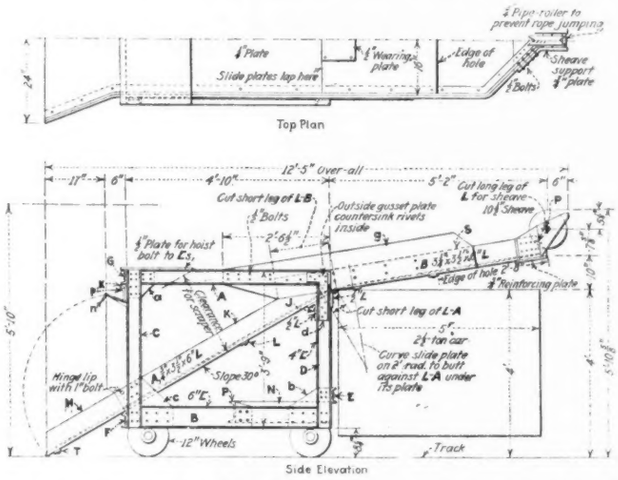


Fig. 2—Sketch showing Type D scraper loader developed at Casapalca, Peru. The letters refer to the details in Fig. 4

bottom 2½-ton cars, for which the larger Type D loader was designed.

The veins in the mines at Casapalca are narrow and crooked. Headings are usually 6x8 ft. in the clear on all but main haulage levels using 2½-ton cars, on which they are 7x9 ft. However, regardless of the size, the many turns in the vein make a short loader essential, and, at the same time, one that has a minimum width commensurate with ample capacity of scraper.

Reference to Table I will show that the size of loaders has been reduced to the least possible dimensions for the cars used with them. Small size not only facilitates moving the loader from one place to another, or to and from the face, but it also allows free passage at the heading. Either Type A or Type D, when dismantled, can be put on a mine cage. Dismantling consists in taking off the front lip (two bolts), removing the boom (ten bolts on each side), taking off the trucks (two bolts for each wheel), and removing the hoist.

Table II—Dimensions of Cars

(Size of Box)

	Length, Ft.	Length, In.	Height From Track Ft.	Height From Track In.	Width, Ft.	Width, In.
1-ton	3	8	3	8	2	3
1½-ton	4	0	4	0	2	8
2½-ton	5	0	4	0	3	0

Details of Construction

In the first loaders the boom was bent on an arc at the frame, but since the bending of the angles involved a great deal of work, it was decided to continue them straight, cutting off the short leg at a point such that the bottom plate of the slide could be bent downward. This gives, also, a strong reinforcement for the large gusset plate. The short leg of both members *A* and *B* (see Fig. 2) should be cut about 4½ in. from the point at which the lower edges of these two angles meet. By so doing, the slide plate of the boom can be curved in an arc and fitted under the plate of member *A*, which should project ¼ in. beyond the point where the short leg has been cut. Thus the ½-in. wearing plate, already mentioned, should not come to the edge of the plate, but this distance back of it. It should be beveled to a knife edge at each end so that the scraper will not catch under it.

The entire slide is made of ¾x3½x6-in. angles with the long leg vertical. This heavy angle has been adopted after having had a lighter one buckle completely at the bend in the rear.

Inside width of the slide has been reduced to 2 ft. 8 in., which has been found sufficient for all purposes. Standard width of scraper has been set at 2 ft. 6 in. over all, thus allowing 2 in. clearance on the slide. This is ample; in fact, greater clearance will result in jamming the scraper by rocks that fall from it.

The yoke of the scraper is bent at 45 deg., which prevents it from catching on any obstructions in its path; of these there are usually many. At the same time, this allows the rear end of the loader to be bent in the same way, so that its over-all length is that at the sheave only, and its effective length in going around curves is much less.

By hooking the hinged front lip to the frame when moving the loader, the length is further reduced by some 17 in., and as the track level is usually the place where are most of the narrow places and obstructions, such as pipe lines, the hinged lip is a decided advantage.

The axle of the sheave should be so secured that it cannot turn. The sheave should have a deep groove, with plenty of flare to the flanges so that the rope will not jump out with the constant jerking as the scraper goes through the muck pile. By putting a pin across the ends of the two supports with a pipe around it, a great deal of this trouble may be eliminated. Because the sheave for the head block is inclosed in plates, there is no difficulty with it from this source.

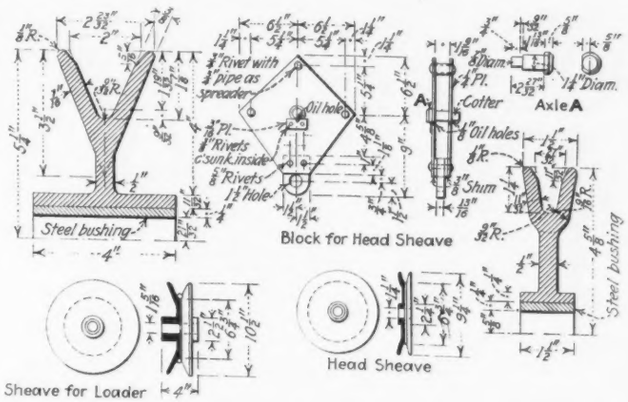


Fig. 3—Detail of sheave for Osana loader

Owing to the heavy wear on the sheave and its supports, bolts should be used in fastening the supports to the boom, so that they may be readily taken off and repaired when necessary. The long legs of the angles of the boom must be cut away sufficiently at the point of the V to allow the sheave to enter.

The size of the base plate for the double-drum hoist is determined by the type of hoist used. In all cases, however, clearance must be allowed for the scraper to pass below it. For the scraper used with it this must be at least 22 in., and preferably 24. It is this clearance that makes it necessary to project the plate beyond the frame on the Type A loader. The plate is secured to the flanges of both the side and front channels by as many bolts as are deemed necessary—about twelve.

An outside gusset plate is attached to the upper rear corner of the frame, with rivets countersunk inside, to form the joint between the horizontal and vertical channels. The axles of the wheels are carried on outboard bearings attached to the lower channels of the frame. A bumper may be put in the frame to prevent the cars from deforming the rear channel when they are pushed under the loader. A roller is put under the front top channel of the frame as an idler for the rope when the scraper is on a high muck pile.

Table III—Time Studies of Hand and Loader Operations

(Car holding 2½ Tons)

	Mucking Minutes per Car	Mucking Man-Minutes per Car	Mucking Man-Minutes per Ton
By hand	15.30	67.60	28.95
By loader	6.83	32.95	14.40

Time per Car for All Operations—Minutes

	Hand	Loader
Mucking	15.30	6.83
Tramming	12.10	10.40
Loafing	1.70	1.10
Total	29.10	18.33

Type of Scrapers

The large number of scrapers that have been developed in recent years all over the world makes it almost useless to go into detail on this subject, but as we had to do a great deal of experimenting before we found

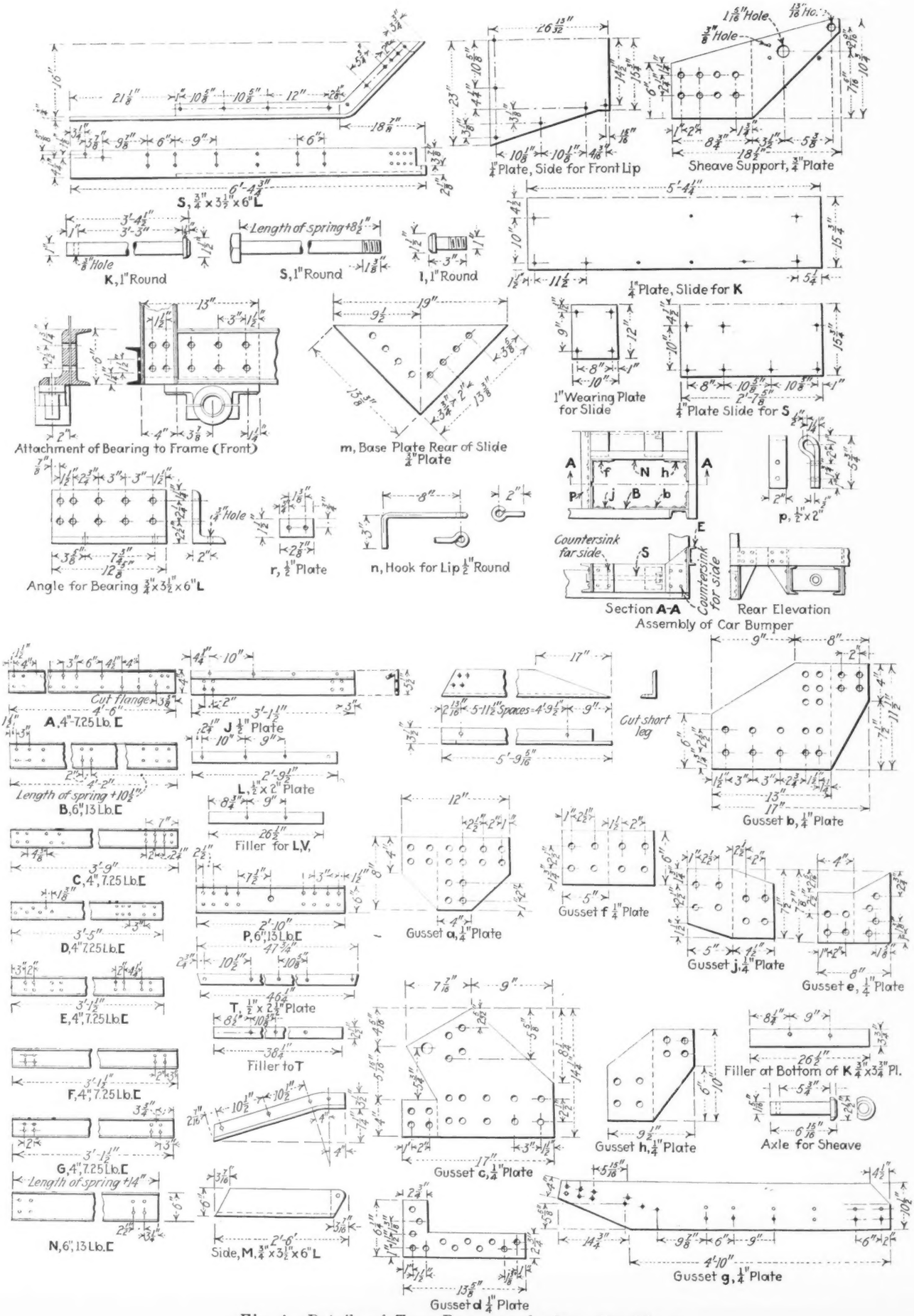

S, 3/4" x 3 1/2" x 6" L
K, 1" Round
S, 1" Round
I, 1" Round
1/4" Plate, Side for Front Lip
Sheave Support, 3/4" Plate
1/4" Plate, Slide for K
Attachment of Bearing to Frame (Front)
m, Base Plate Rear of Slide 3/4" Plate
1" Wearing Plate for Slide
1/4" Plate Slide for S
Angle for Bearing 3/4" x 3 1/2" x 6" L
r, 1/2" Plate
n, Hook for Lip 1/2" Round
p, 1/2" x 2"
Section A-A
Rear Elevation
Assembly of Car Bumper
A, 4"-7.25 Lb. C
J 1/2" Plate
L, 1/2" x 2" Plate
B, 6"-13 Lb. C
Filler for L, V
C, 4"-7.25 Lb. C
D, 4"-7.25 Lb. C
P, 6"-13 Lb. C
T, 1/2" x 2 1/4" Plate
E, 4"-7.25 Lb. C
Filler to T
F, 4"-7.25 Lb. C
G, 4"-7.25 Lb. C
N, 6"-13 Lb. C
Side, M, 3/4" x 3 1/2" x 6" L
Cut short leg
Gusset b, 1/4" Plate
Gusset a, 1/4" Plate
Gusset f 1/4" Plate
Gusset j, 1/4" Plate
Gusset e, 1/4" Plate
Filler at Bottom of K 3/4" x 3/4" Pl.
Axle for Sheave
Gusset h, 1/4" Plate
Gusset c, 1/4" Plate
Gusset g, 1/4" Plate
Gusset d 1/4" Plate

Fig. 4—Details of Type D scraper loader. See Fig. 2

one that gave satisfactory results for all classes of work, it will be well to outline the salient points of the model finally developed.

The small teeth on the scraper are reversible, so that they may be turned end for end. Under them is a removable plate that protects the main plate of the frame from wear. The long teeth are of a single piece, but can be taken off when worn. These also could be made reversible by drilling two rivet holes on the other leg and changing the shape so that it is symmetrical; but they are so little used that this expedient is hardly necessary.

The feature of the curved yoke, already mentioned, cannot be too strongly emphasized. It is especially noticeable when the scraper comes in at an angle to the loader, which it will do in a great many cases. This scraper is simple in design and easy to construct, but can still be greatly improved as ideas suggest themselves with experience.

Use of Loaders

Outside of the use in headings, the loaders have proved of great value in cleaning up cutting-out stopes, in which the ore is broken down on the track in preparation for stulling and shrinking. The resulting muck pile is about 15 ft. high and as long as the stope. As soon as the blasting has been advanced sufficiently so as not to injure the loader, mucking is started. The loader is placed at the edge of the pile and advanced once a shift. As the Type A loader will load a 1-ton car in from three to four minutes, with native labor, the speed depends mostly upon the number of carmen that are employed and the distance of the loader from the chute.

One of the loaders is working in a large tunnel in which the track is carried on stulls 3½ ft. above the bottom. Here a slide is put in up to the level of the track and ballasted before blasting. The loader handles over 100 tons of rock in about five hours, loading into 1½-ton cars, or, in approximate figures, 20 tons per hour.

Conclusion

To date, we have in use six loaders at Casapalca, and are building others. Six have been made for the Morococha Department of the Cerro de Pasco Copper Corporation, and the use of twelve more is under consideration. One has also been asked for a power-tunnel project of the same company. In addition, two larger loaders of the same general design were built for a railroad tunnel and proved successful, though no doubt a mechanical loader would have been better had the size of the job on which it was employed warrant it, which it did not.

The cost of building one of these loaders at Casapalca is about $350, complete with scraper. To this must be the cost of a double-drum hoist. This figure should be much lower in the Uniter States in view of the different conditions obtaining there.

Though it may be that others have developed the Osana loader along similar lines, the types herein described have been worked out entirely in Casapalca. We feel greatly indebted to the originators in having given us the basic principles upon which to work, for we have done nothing more than change and modify until we had a loader to suit our conditions, and one which, we believe, will be found to have a wide range of use elsewhere.

A Method for the Complete Analysis of Fluorspar

A method for the complete analysis of fluorspar was recently described by E. Bailleux (Bull. Soc. chim. Belg., 1926, 35, 305—310) and abstracted in *British Chemical Abstracts*. Loss on ignition is determined by heating 2 g. of the sample at 300 deg. C. until the weight is constant. The residue is digested with 150 c.c. of 10 per cent acetic acid for 30 minutes on the water bath, and the insoluble portion is collected, ignited at 300 deg., and weighed; loss in weight is reckoned as calcium carbonate.

Exactly one-half of the residue (= 1 g. of original sample) is evaporated with 3 to 4 c.c. of concentrated sulphuric acid and 3 c.c. of hydrofluoric acid to expel silica and convert all fluorides into sulphates. The residue is dissolved in 10 per cent hydrochloric acid and the solution used for the determination of iron and alumina and of the lime present as fluoride and sulphate. Silica is determined from the loss of weight when the second portion of the acetic acid-insoluble is evaporated with hydrofluoric acid to dryness, and the residue calcined after again evaporating with ammonia.

The residue is digested with nitric and hydrofluoric acids, and the excess is expelled on the water bath; 50 c.c. of ammoniacal acetate-citrate mixture (500 c.c. of 65 per cent acetic acid and 80 g. of citric acid made up to 1 liter with ammonia) are added to dissolve calcium sulphate and ferric fluoride, leaving a residue of pure calcium fluoride which is collected and weighed. Calcium sulphate is found by determining the lime in the acetate solution. Corrections are made for the solubility of calcium fluoride in acetic acid (0.002 g. per 1 g. of sample) and in the ammoniacal acetate solution (0.0025 g. per 1 g. of sample).

Sulphuric Manufacture in the Southwest

Eight years ago the Calumet & Arizona Mining Co. constructed a sulphuric acid plant in connection with its smelter in Douglas. At that time the only large market for the product was at the leaching plant of the New Cornelia Copper Co. at Ajo, Ariz. Since that time the New Cornelia has largely exhausted its oxide ores near the surface, and is now producing mostly sulphides. However, it is still mining several thousand tons of oxide per day.

About five years ago another large consumer of sulphuric acid came into the market—the Apache Powder Co., near Benson, which manufactures nitroglycerin for its million-pound production of powder per month.

Last year a third large consumer of acid came into existence—namely the leaching plant of the Inspiration Consolidated Copper Co.

During January, 1927, the Calumet & Arizona Mining Co. made and sold 6,800 tons of sulphuric acid.

France Increases Production of Potash and Bauxite

Appreciable increases were recorded in the production of potash in France during 1926, according to statistics of the French Ministry of Public Works, made public by the U. S. Department of Commerce. The production was 366,670 tons, against 310,168 tons in 1925. The output of bauxite rose slightly during the year to 408,600 tons, against 406,535 tons in the year before.

Practical Economic Value of the
Service of a State Geological Survey

By Wilbur A. Nelson
State Geologist of Virginia

Wilbur A. Nelson

THE AIM of a successful geological survey should be the getting of accurate and detailed information — basic facts—about all the natural resources of the state and furnishing this information to the public in the form in which it can best be used for successfully and speedily developing such resources to the utmost. The work of a successful state survey will indicate in what ways such development can best be concentrated and into what major subjects the work should be divided.

In the reorganization of state governments which has taken place in a number of the states in the last few years, and which is being considered more or less actively by most of the other states, it is to be noted that, in practically every instance, a department dealing with the development of the state's resources, and also with the formulation of a proper conservation policy, occupies a prominent place in reorganization plans. The grouping of all such activities in such a major department is the outgrowth of the work done by the state geological surveys under different names in most of the states of the Union during the last 25 to 100 years.

When the first state geological surveys were started, all were planned to be of a temporary nature. As the work of these surveys progressed, it was soon evident to the men of vision of that period that such geological surveys, with their allied work, should be of a continuous and permanent nature if the state was to receive the benefits which it should acquire from such scientific and economic work.

The "One-Man" Survey

Naturally, the old state surveys were not organized along identical lines, and few of them had the same problems or developed relatively similar methods for conducting their work. As a rule, all depended for their success on the vision and energy of one man or a small group of men living within the particular state, and this same condition of affairs still exists, to a great extent, in many of the states of the Union.

In recent and current reorganizations of state governments the new major departments, known by different names, but generally including the words "conservation and development" in their titles, have taken and are taking over all of the duties of the old state geological survey. Often the work of the old survey is divided into many subdepartments. The work of the state geological survey is being confined purely to geological research, irrespective of whether or not the state geologist is capable of handling, as he did successfully in the past, work in allied subjects, such as topographic mapping, water resources, parks, and forestry. It is probable that, in some states, this regrouping of departments may result in too much red tape and in a multiplication of state offices, with undue expense accruing to the state. It may also result in placing men in charge of such work who are more interested in their personal advancement than in the future development of the state in which they have grown up and of which they are truly an integral part. The state geologists of the past were men who, in practically every case, were intensely interested in their science and in the development of their particular state, and cared little for personal advancement or for a proper remuneration for their services. Probably, on this account work of this sort was not generally appreciated in the past by the legislatures and governors of our several states.

The service that a state geological survey is called upon to furnish has changed greatly from that required twenty-five to fifty years ago of the old state organizations. At present the majority of people in most of the states, including many of the politicians, are interested in a state survey only when it can show tangible results in the development of new or latent resources, so that increased taxable values are produced which can be definitely shown and which can be used as a basis in asking for adequate appropriations from the state legislatures.

Importance of State's Natural Wealth

The wealth of a state or of its political subdivisions is private wealth. Yet the prosperity of a state depends mainly on this wealth. It is therefore an important state duty to determine where hidden wealth, such as mineral deposits and water-power possibilities, exists within the state. As the lands of the state are owned in more or less small parcels, and as the scientific and engineering work which must be done to determine what hidden wealth exists must be collected from the state as a whole, or from districts where conditions are similar, it follows necessarily that the carrying on of such work is not the duty of private individuals, as these problems cover greater areas than those of any individual holdings.

To carry through successfully a program in which scientific studies of future requirements are made, and to adopt an orderly program for such scientific research work, will undoubtedly result in bringing to light within a state many unknown resources which will produce new taxable wealth.

The state has many activities, but back of all of them is the great question of taxation and revenue. In the past, little attention has been paid to increasing taxable wealth, and it has been the policy to raise tax rates when more revenue was needed, instead of attempting to increase taxable wealth, even though the undeveloped resources of a state were known by many to be worthy

of immediate development. To that state agency whose duty it is to increase taxable wealth is now offered a great opportunity; for, although it is recognized that the necessary work of the state and government demand more revenue, it is likewise recognized that tax rates should be lowered. These two results can be accomplished only by the development of new resources of taxable wealth through the development of latent resources and of manufacturing industries that are dependent thereon.

Present-day taxation is based largely on industrial activity; revenue is based on industrial activity. In our existing state of political development, therefore, the importance of stimulating industrial development is apparent and urgent. Leaders of vision and molders of public opinion should create opportunities for the logical development of state resources. To the state geological survey should be assigned those duties which, if adequetely supported by the state and faithfully performed, can do much toward placing a state on a firm footing of prosperity, for the development of natural sources creates new taxable values out of old, dormant sources.

The most highly successful state geological surveys of this day are of a new type that is very different from that of their predecessors. They now, to a great extent, must devote their energies to an immediate application of scientific knowledge to industrial development. When they do this successfully, taxable wealth is no longer left to develop as the whims of a promoter may dictate.

Value of Topographic Maps

One is unable to do the geologic work on the mineral deposits of a state and carry on water-power studies unless detailed topographic maps are available. Such maps are absolutely necessary in connection with mapping the mineral deposits of a state, in road-location work, water-supply problems for towns, flood control and prevention, drainage engineering, railroad building, military considerations, forestry work, and soil mapping. The cost of making the standard quadrangle topographic map varies from $25 to $80 a square mile, and each one of these maps covers approximately 250 square miles. It is necessary to appropriate sufficient funds for such mapping, so that the area covered each year will permit maps to be made of the entire state within twenty-five years or less. Even this is too long a period if the state is to be developed as it should be. One cannot overemphasize the value of such maps in showing possibilities for hydro-electric developments which were not even known to exist until such detailed maps were made.

The great value of topographic maps in road-location work was shown on one particular project during 1925, when the State Geologist of Tennessee induced the Tennessee Highway Department to let him arrange for the U. S. Geological Survey to make a strip topographic map through a section where a new road was contemplated, the projected road to extend from La Follette to Jellico, Tenn. Before the Highway Department was induced to make the above-mentioned strip map, it had sent a party out in the field to run the best line between these two points that could be found. This party spent more than $5,000 in making such a survey, and ended with a road 26.3 miles long.

After receiving this strip map, made in co-operation with the Tennessee Highway Department, the State Geologist had a conference with the division engineer of the Highway Department, and they located on this strip map a road between La Follette and Jellico which in no place has over a 6 per cent grade, and which was exactly 19 miles long. This was a reduction of 7.3 miles, which will effect a saving of more than $300,000 in the completion of the road between these two points. In addition to this, the cost of running the final survey of the proposed highway will be less by several thousand dollars, because the field parties will be furnished with a strip map. The value of this map to this state is thus plainly apparent. All this money will be saved to the State of Tennessee by the expenditure of only $1,100, which represents the amount that was paid by the Highway Department as its share in making the above-mentioned strip map, provided this department uses this feasible route.

The great value of topographic maps in road-location work has also been shown in the last few years in a number of other states besides Tennessee, but particularly in Wisconsin, Missouri, and Illinois; work essential to the provision of such maps should be carried on as rapidly as possible, as through their use hundreds of thousands of dollars can be saved to the state in other work in which it may be engaged.

Development of Hydro-electric Power Resources

In many states the state geological survey has charge of water resources. Intelligent development, operation, and administration of the country's water resources, based on reliable records, have added billions of dollars to the taxable values of the nation and contributed in a large measure to the general prosperity. On the other hand, disaster to agricultural communities, financial wreck of power projects, and the waste of millions of dollars in misdirected municipal and industrial enterprises have resulted from lack of accurate information as to the quality, quantity, and seasonal distribution of the water flowing in the rivers utilized as sources of water supply. It follows that the value of much real property is based largely on the water supply available. The right to use this water, which rests on findings by state officials, on constitutional provisions, and on decrees of courts, rests in turn on the integrity of the records of river discharge. The basis for many values, for the sound and economic use of water, and for the administration of water laws and rights, must therefore be authoritative records of water supply extending over a period of years.

Data on Stream Flowage Indispensable

The quantity of water in a river is not uniform. It changes not only from hour to hour, day to day, and season to season, but from year to year and by periods of years. A short-time record of river discharge, therefore, is not an adequate basis for making plans leading to the investment of capital, for the adjudication of water rights, or for making the distribution of the flow among the several users. Moreover, the need of records must be anticipated, so that they may be available and adequate to serve the purpose of sound economic development.

In the struggle for more and yet more electric power water is the controlling factor. Water-power sites will be utilized whenever and wherever they are economically feasible. Steam-power plants will be built as they are needed, but they must be located where large quantities of water are available for the condensers. As 600 to 1,000 tons of water is used for every ton of coal burned, no large steam-power plants can be built except where

there is positive and definite assurance of the availability of sufficient water at all times.

Few think of the part minerals play in city life, in the farmer's life, and in the country's development. It is true that initial prosperity depends on agriculture, and in the past ages the rich agricultural countries were dominant in world affairs. Now conditions have changed, and if a country or a subdivision of it is to have a dominant place it must be able to produce mineral wealth in quantity and cheaply, in addition to purely agricultural wealth. It must develop and have in reserve the great basic minerals of this age: iron, aluminum, copper, lead, and zinc. It must have the power necessary for turning these minerals from the raw-ore condition into the finished metal ready for the hands of the artisan to fashion, by intricate machinery and industrial processes, into the major articles of commerce. And even our purely agricultural wealth would be a thing of the past, existing only in areas of virgin soil or river flood plains, if it were not for the mineral fertilizers which come to the farmer's aid—phosophate, nitrates, and lime.

It can thus be seen that the activities of a state geological survey tie in intimately with the work and welfare of all of the people of the state, as would be expected in such a complex civilization as we have at the present time. It may surprise many to know that there are still large areas in the East and South, as well as in the West, where very little is known of the geology and mineral resources. Reconnaissance work in many states is not yet completed, and, with one or two exceptions, a large amount of detailed geological work still remains to be done in every state. The great non-metallic group of minerals has been developed to only a very small extent in many sections of the country, and this is preeminently true of the Southern states. Even our metallic mineral deposits must depend more and more for successful development on the detailed scientific work of geologists—work which it is proper should be done by the personnel of a state geological survey.

The scientific work of a state survey cannot be overstressed, and reports, to be of the greatest value for the greatest number of years after they have been published, must be written in a purely scientific spirit and must cover the most minute scientific details. Many things recognized by the scientist as existing at the time the report is written, and not then of economic importance, may be of much economic importance fifteen or twenty years later. Anyone who will read carefully the accurate scientific reports gotten out by some of the old state surveys, and prepared by men such as Branner, Safford, Hildegarde, and others, will recognize how much present-day use can be made of their old reports.

Development of Bauxite Industry in Mississippi

Only a few years ago valuable deposits of bauxite were found in Mississippi by a man who, by reading Hildegarde's report published about the time of the Civil War, ran across a perfect description of bauxite ore, but, as bauxite was not known as an ore at that time, it was not mentioned by Hildegarde as of any economic value. Yet today bauxite deposits in Mississippi are being developed as a result of the scientific information dug out of this valuable old state publication. This should indicate the importance to those in charge of the present state geological surveys, of great care in preparing their reports with full scientific detail and with descriptions of the resources which are considered of economic value at the time of writing the report.

The development of a state's resources depends to a great extent on transportation, and the increasing of taxable wealth demands that the transportation facilities of an area be so devised, or so used, where they have already been estabished, that industries can be developed which can economically gather in raw materials and then distribute the manufactured articles over a large area under freight rates as low as, or lower than, those enjoyed by competing centers.

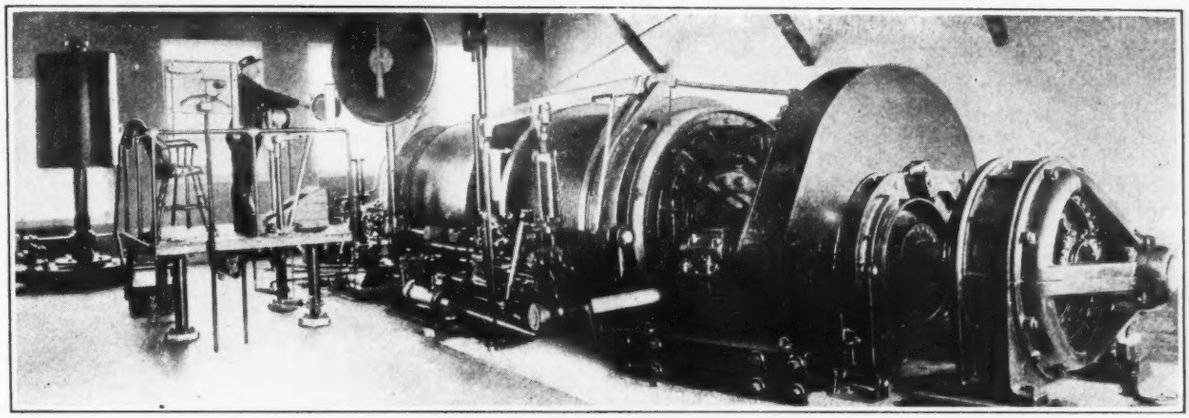
The era of a great railroad development has probably passed, but engineers and industrialists of the present should realize the importance of railroad cut-offs which will lessen the distance between the principal cities of the country and leading seaports or places where new seaports can be developed.

Transportation likewise plays an important part in the study of agricultural adjustment to present conditions—a study which is intimately connected with the industrial development of a state.

In enumerating the service features of a state geological survey one cannot lay too much stress on the value of educating all the people of the state in a knowledge of the state's natural resources. The children in a state should be afforded an opportunity to learn the facts concerning the state's natural resources, so that they may realize its opportunities for advancement. When any generation of people has learned this true lesson, it will see that its natural heritage is conserved and developed for the good of all. Then will those in charge of a state geological survey be able to say that their organization has been of lasting benefit to the state. Then they will get proper support for their work, which will be recognized as affecting the welfare of all the people.

Potential Cobalt Supply Exceeds Demand

Discussing the situation of the cobalt market, says *The Mining Journal*, of London, a writer in the *Journal du Four Electrique* recalls that since the discovery and turning to account of the deposits in the Belgian Congo, the Canadian metal has been faced with a keen competitor, which might have wiped out the industry in the Dominion but for the agreement arrived at between the producers in the two countries. In 1925 the Canadian production was 85 tons cobalt metal and 250 tons oxide, while the Congo production amounted to 750 metric tons of copper-cobalt-iron alloy, from which 300 metric tons of cobalt metal were produced in the Oolen works, all the Congo ore being treated in Belgium. The writer says that the Belgian production is limited only by the restricted market for cobalt, and that the electric furnaces at the Panda works have a capacity three times that indicated by the output of 1925. There is, he says, no doubt that if the uses for the metal were to be developed, the Belgian production could easily follow suit, and that the present price could be materially reduced, particularly when the projected harnessing of the Lufira and the Lualaba falls has been carried out. The writer refers also to the New Caledonian production, which amounted in 1914 to 445 metric tons of ore, and adds that of the four mines in Spain, which have been idle for several years, the Aramo mine, at Pola de Lena (Asturias), and the Profunda mine, in the Province of Leon, were re-started in 1925 by the recently floated Sociedad Metalurgica del Cobre y Cobalto.



Double-drum hoist at Teck-Hughes mine. The drive is a 225-hp. motor, with full-magnetic control

Hoist Control in Northern Ontario

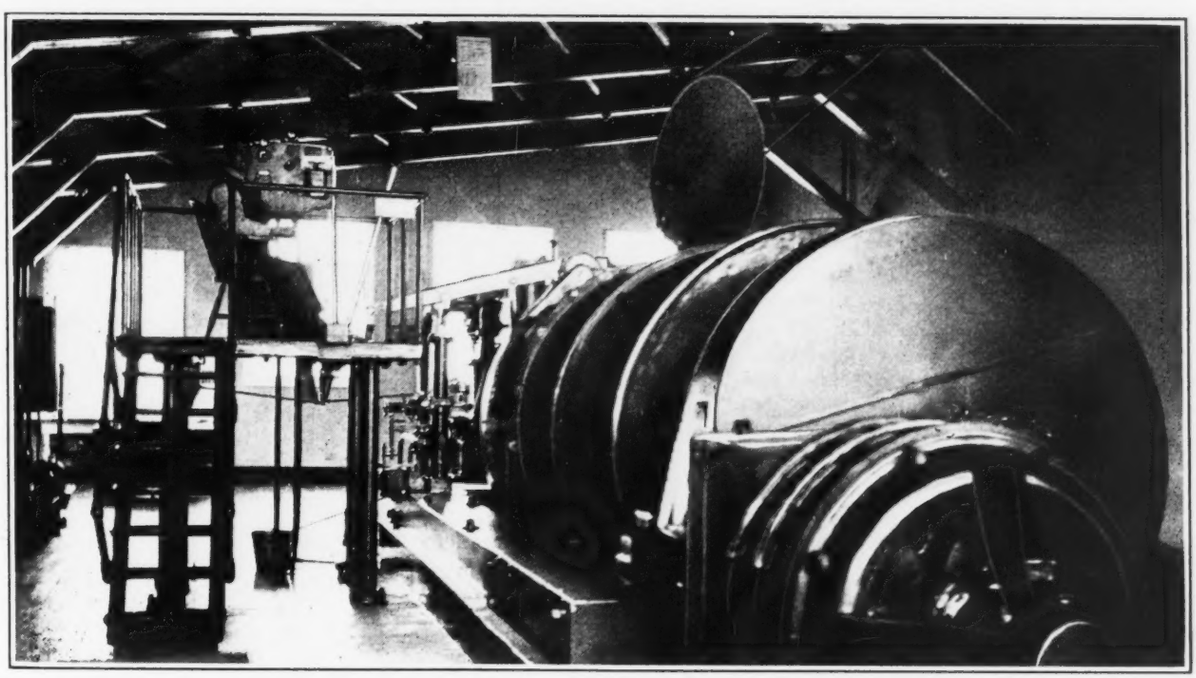
By A. Brian
Canadian General Electric Co., Cobalt, Ont.

ALL OF THE MINING CAMPS of Northern Ontario have had the advantage of electric power almost from the start of operations. There are a large number of water powers throughout the district, many of which have been developed. Practically all air compressors in the district are motor-driven, and all the crushing and metallurgical plants have electric drive. Perhaps the last adaptation of electricity was for underground haulage and the hoisting of ore to the surface.

Magnetic control was first used at Cobalt, it is believed, in the form of automatic starters for pumps installed underground. One of the earliest of these was an automatic starter installed by the Nipissing Mining Co. in 1914. This is still in service and has had practically no repairs. Recently, in some of the newer camps, the automatic starter for compressor motors has been introduced, particularly for synchronous machines.

Practically all methods of hoist control are in use, the more modern being at the gold mines in Porcupine and Kirkland Lake. In Porcupine the tonnages handled are much larger and the depths greater.

The Hollinger mine, at Timmins, in some respects is the greatest gold mine in the world, its present capacity being close to 8,000 tons of ore daily and its gold production around $20,000,000 annually. It recently installed two new electric hoists for hoisting ore at a speed of 3,000 ft. per minute. These, it is claimed, are



Single-drum hoist at Teck-Hughes mine, Kirkland Lake, Ont., driven by 125-hp. 30 deg. induction motor. A divider on the drum permits the use of a counterweight

the largest, mechanically, in North America, and are driven by 2,000-hp. induction motors controlled by liquid rheostats. The main hoist at this mine is equipped with Ilgner-Ward-Leonard control.

At the adjoining property, that of the McIntyre Porcupine Mines, a main shaft is now being sunk to a vertical depth of 4,000 ft. The main ore hoist is not yet installed, but the control will be of the Ilgner-Ward-Leonard type. That hoist will also have a rope speed of 3,000 ft. per minute. The sinking of this shaft is being accomplished by a hoist operated by a 400-hp. induction motor with full magnetic control.

Because of the preference for liquid rheostats, it was some years before magnetic control for hoists could be introduced. During the last two or three years, however, some installations have been made which are proving satisfactory. Among these are two at the Teck-Hughes gold mine, in Kirkland Lake. These are typical of general practice.

The first installation consisted of a Nordberg single-drum hoist with a divider on the drum for using a counterweight to give balanced operation. This hoist is capable of working to an ultimate depth of 3,000 ft., but has been used mainly for sinking a new shaft which has now reached a depth of approximately 2,000 ft. It will ultimately be used as a man and material hoist. It is driven by a 175-hp., 450-r.p.m., 2,200-volt, 3-phase, 60-cycle motor with full magnetic control. This control includes the following:

A primary switchboard panel, with necessary oil circuit breaker and instruments.

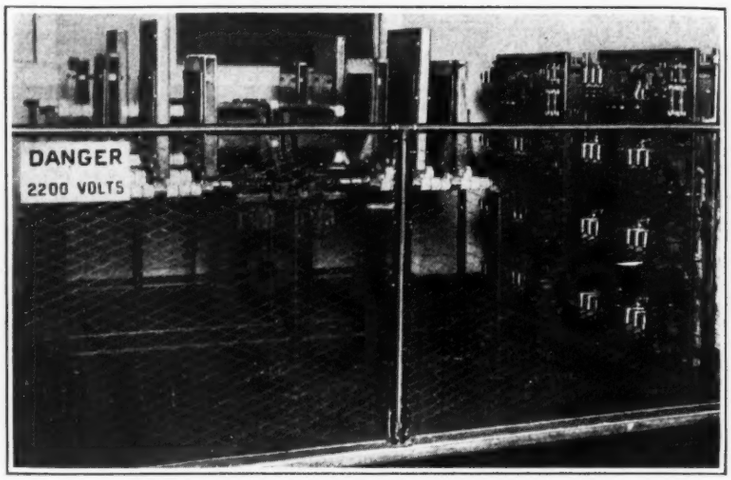
A primary reversing panel, consisting of triple-pole, 75-amp., interlocking reversing contactors.

A secondary panel consisting of six double-pole, 300-amp. accelerating contactors, each with a time-limit relay; one double-pole, 300-amp. accelerating contactor without relay; one double-pole, 75-amp. undervoltage protective contactor and necessary switch with fuses and accessories; one master switch, an emergency switch, and a backing-out switch.

Time-limit relays were supplied on the secondary acceleration contactors, instead of the usual current-limit type. This was done at the request of the power company, which was having trouble with the regulation of its substation at the end of a 65-mile transmission line. The power company felt that the time-limit relays would give the regulator at the substation time to adjust the field of a synchronous condenser. Acceleration of this hoist is accomplished in ten seconds and so smoothly that the operator at the substation is unable to detect when the hoist is starting. This is contrary to the experience with home-made liquid rheostats, which caused a surge on the distribution system.

The hoist is equipped with oil-operated post brakes and has an emergency solenoid brake and Lilly safety features. In addition, there are two track limit switches in the headframe.

Early this year another and a larger hoist was installed at this property for main ore hoisting. This is a double-drum hoist with features of control similar to those described. It has a slightly higher rate of hoisting speed. The motor in this last-mentioned installation is a 225-hp. unit, operating at 600 r.p.m., 2,200 volts, and the control is full-magnetic.



The control panels for the single-drum hoist at the Teck-Hughes mine

French Iron-Ore Production Sets High Record

Production of iron ore in France in 1926 set a new high record, with a total of 39,480,400 tons, an increase of 3,739,205 over the total of 35,741,192 tons produced in 1925, according to advices to the U. S. Department of Commerce from the office of the commercial attaché at Paris. This increase in output was continued in the early part of 1927, the January production of 3,799,796 tons representing a considerable gain over the December total of 3,581,702 tons.

Total French exports of iron ore in 1926, amounting to 11,233,897 tons, were larger than the total of 9,226,688 exported in 1925 but smaller than the 1924 total of 12,296,377 tons. French imports of iron ore during the past year totaled 1,386,854, compared with 1,242,317 tons in 1925. The output in 1924 was considerably less, being a little over half that in 1926, or 724,674 tons.

With regard to the leading regions producing iron ore in France, statistics for 1926 show that the Metz-Thionville region was responsible for a total output of 17,079,900 tons in 1926, compared with 15,456,515 in 1925; the Briey-Longwy region produced 18,863,900 tons, against 17,212,635 in 1925, and the Nancy region registered an output of 1,244,700 tons, compared with the 1925 production of 1,030,980 tons.

A New Map for the Prospector

A geological map that will be greatly welcomed by the prospectors is one just published by the Canadian Geological Survey and known as the Nottaway sheet. It shows on a scale of eight miles to one inch that part of Quebec extending from the Quebec-Ontario boundary on the west to beyond Chibougamau Lake on the east and from the vicinity of the Canadian National Transcontinental Railway on the south to beyond Rupert River on the north. The large areas underlain by rocks of Keewatin age are shown. These are the early Pre-Cambrian formations which experience has proved to be favorable to the occurrence of economic minerals. Copies of the map may be had on application to the Director, Canadian Geological Survey, Ottawa, Ont., Canada.

On Ore Magmas—I

By J. H. L. Vogt
Trondhjem, Norway

THE NEW IDEAS concerning the genesis of ore deposits, introduced by J. E. Spurr in "The Ore Magmas" (Vols. I and II, 1923) and in a series of other publications, and the discussion between Spurr and W. Lindgren,[1] furnish a motive for me to give a summary of my own views concerning some of the problems in question.

On Magmas in General

The term "magma" has long been used to designate the high-temperature liquids which on cooling gave rise to the igneous rocks. Since by far the most of these rocks consist principally of silicates, it was unquestioningly presumed, in the first decades of the petrographical science, that all igneous rocks should be composed principally of silicates. In accordance with this the magmas were originally considered as silicate melts, carrying more or less dissolved light volatile compounds. This limitation can, however, no longer be retained. To illustrate this, I shall take an example.

In the gabbros, consisting of, say, a few per cent of titanic magnetite, 30-40 per cent ferromagnesian silicates, and 50-60 per cent labradorite, one sometimes meets with basic facies, containing:

Ti = Magnetite (or Ilmenite), Per Cent	Fe, Mg = Silicate Per Cent	Labradorite, Per Cent
25	45	30
40	50	10
60	40	0

Melts which on cooling give rise to rocks of such composition may also, according to the original interpretation, be designated as magmas.

From rocks carrying, say, 60 per cent iron-ore mineral and 40 per cent ferromagnesian silicates one may sometimes prove gradual geological and petrographical transitions to rocks carrying still more—even 90, 95, 97, or 98 per cent iron-ore mineral (magnetite, ilmenite); while, on the other hand, the mixture of the silicates sinks down to a trifle. And one can state that these last-named rocks or iron-ore rocks—sometimes of rather great dimensions, covering areas of 0.1, 0.2, 0.3 square kilometers, and in places still more—have been solidified from a melt, carrying sometimes only a trifle and sometimes considerable dissolved light volatile compounds. While one cannot draw a geological or petrographical boundary between the high-temperature liquids or melts, which at cooling formed a gabbro, and those which formed at the other extreme a magnetite or ilmenite rock, practically without any silicate at all, the term "magma" or "iron-ore magma" has been used for several decades, in Norwegian and Swedish literature, to designate the melts of the last named rocks or ore rocks.

In a similar manner we have used the term "sulphide-magma" for the melts which gave rise to the magmatic sulphide deposits of the types Erteli-Meinkjær-Sudbury and Röros-Sulitjelma. We also—for example at Kiirunavaara—know almost pure apatite rocks, solidified from apatite magmas. W. C. Brögger in his great work on the Fehn district in Norway[2] has extended the term "magma" to comprise carbonate magmas, and I also agree in Spurr's use of the term "quartz magma," supposedly a solidification from a rather high-temperature liquid. I shall come back to this last-mentioned question later.

Our knowledge of the chemical composition of the igneous liquid solutions which at the transition from the liquid to the solid phase have produced the igneous rocks has in later decades been very considerably enlarged. The above discussion concerning the extension of the term "magma" is thus not only a verbal discussion as to the meaning of a term, but it involves a summary of the progress of the petrographical science in later years. Lindgren restricts the meaning of "magma" too narrowly.

In accordance with the historical development of petrography, the term "magma" should be reserved for the *liquid high-temperature solutions*, often carrying dissolved light volatile compounds in a great quantity. But we should not use the term "magma" for the light volatile compounds themselves, after their escape from the magma, nor for the hydrous solutions, consisting in the main of H_2O, originally escaped from the magma in the supercritical phase and afterward by cooling forming a liquid below the critical temperature (374 deg. or somewhat more, probably approximately 400 deg. for water rich in dissolved compounds). I cannot accept the great extension which Spurr makes of the term "magma," to embrace also hydrous solutions quite predominantly consisting of water, and it is often difficult to ascertain the meaning of Spurr's ore magmas. The question of what to call the child is not essential. But when the child has got a name we should not baptize his brother or his sister with the same name.

On the Formation of Ore Magmas

On the basis of geological investigations we may divide the various ore magmas into several geologically different classes, and this geological classification is in complete accord with the physicochemical phase laws.

I

Due to the Formation of Two Liquid Phases

The (artificial) silicate melts, as well as the silicate magmas of various compositions, are—as far as known till now (December, 1926)—mutually soluble, and this is also true for the magmas with varying contents of silicates, ferrates (or iron oxides), aluminates[3] (and alumina), and several other compounds. But this principle cannot be generalized to comprise all possible compounds.

I shall take an elementary example from the technical practice. By the melting of sulphidic ore we get two liquid phases, matte and silicate slag. The slag dissolves some sulphides—namely, Fe S and ZnS—in a

[1] *Trans.*, A.I.M.E., June, 1926, and *E. & M. J.*, July 24, 1926.
[2] Kristiania Vid.-Selskab (now Acad. of Sci. in Oslo), 1921.

[3] The very high content of apatite in divers igneous silicate and iron-ore rocks and the experiences from the Thomas-slags seem also to prove an unlimited mutual solubility in the liquid phase at high temperature between phosphate (apatite) and silicate, or ferrate (including titan-ferrate). When the temperature of a melt carrying dissolved phosphate sinks below the high melting point of apatite (chlorine apatite = about 1,530 deg. and fluorine apatite = about 1,650 deg.) and the limit of the solubility is reached, we get a separation of apatite not in the liquid but in the solid phase.

rather great quantity, and sulphides such as PbS, NiS, CoS, Cu_2S, and Ag_2S, only in an extremely small quantity, the solubility increasing with the temperature and with the basicity of the silicate slag. And at the melting of roasted lead or copper ore we may even get three liquid phases, metal (lead or copper), matte, and silicate slag.

In the early 90's, on the basis of geological and petrographical investigations, I concluded that the nickeliferous pyrrhotite deposits (Erteli, Meinkjær, Evje, and others, in Norway; Klefva, in Sweden; Sudbury, in Canada, among others) might be explained as magmatic segregations within gabbro (norite) and related rocks; and further it has been ascertained that the process of segregation was due to an exsolution of a separate sulphide magma[4].

The magmas of norite, etc., in question may at a rather high temperature carry some FeS, say one or a few per cent, in solution. When during the cooling process the solubility limit of FeS is reached, some FeS must be separated from the solution in the silicate magma. This taking place at a temperature *higher than the melting point* (about 1,170 deg.) of FeS, we do not get a crystallization of FeS, but a *separation of FeS in the liquid phase*, and in this sulphide magma we also get some FeS_2, CuS (or Cu FeS_2), NiS, CoS, etc.

In silicate magmas of other compositions we may get similar segregations of sulphides, yet of another composition[5].

As to the cupriferous pyrite deposits of the type Röros-Sulitjelma, in Norway, we point out: (1) They are geologically intimately connected with gabbros (and closely related rocks), intruded under a very great dynamometamorphic pressure and at a very considerable depth, at the period of folding of mountain ranges. (2) The formation of the deposits belonged to the magmatic period of the silicate magmas. (3) The deposits in places show structural and chemical transitions to the type of the nickeliferous pyrrhotite deposits and may thus also have been formed by a process of magmatic segregation (J. H. L. Vogt), yet they as a rule show another chemical composition. (4) The texture demonstrates a crystallization from a magma (W. C. Brögger). (5) These sulphidic and very thin fluid magmas contained some admixture of light volatile compounds, especially H_2O, and more H_2O than the magmas of the nickeliferous pyrrhotite deposits (presumed by J. H. L. Vogt and ascertained by Th. Vogt). The quantity of the dissolved light volatile compounds, H_2O (with some H_2S, etc.) seems, however, not to have been very great.

Gradual transitions between mother rock and ore deposits (lacking the physicochemical process of the separation) have not yet been determined. Probably here also we have to deal with the exsolution of a separate sulphide magma. As to the manner of intrusion I refer to some remarks below.

II

Due to the Concentration of the First Crystallizing Minerals

Under this head we especially mention:

(1). The chromite deposits, sometimes accompanied by platinum metals, in peridotites (with pyroxenites and other closely related rocks).

(2). The titaniferous iron-ore deposits, type Taberg, Rautivare, Ekersund, Cumberland, etc., in gabbros and other basic and intermediary rocks.

(3). The iron-ore deposits containing only a very little titanic acid, type Kiirunavaara-Gellivare, in northern Sweden,[6] and Solberg-Lyngrot, in southern Norway[7], accompanying acid igneous rocks, with about 70-75 per cent silica.

Referring to previous studies by myself and many other investigators, we point out: (1) That the ore rocks treated here have crystallized from a magma (ore magma) and (2) that the minerals characterizing the ore rocks are those which in the mother rocks[8] were separated at the first stages of the cooling.

The first minerals to crystallize in the peridotites were chromite (with chrome spinel, picotite), and in accordance herewith the basic ore segregations in the peridotites are characterized by chromite.

The first minerals to crystallize in the ordinary gabbros were apatite, titanomagnetite (or magnetite-ilmenite), and divers ferromagnesian silicates (olivine, hypersthene, diallage); and just these minerals, very often accompanied by spinel (pleonaste) and sometimes by corundum, characterize the titaniferous iron-ore deposits within the gabbros. At the deposits of the type Kiirunavaara-Gellivare and Solberg-Lyngrot, titanomagnetite (or magnetite-ilmenite) is replaced by magnetite, and this may be explained by the ore mineral in the acid rocks in question being a magnetite, only with a very low percentage of titanic acid.

Referring to my paper on Kiirunavaara-Gellivare mentioned above, and to the future No. III of the series on "The Physical Chemistry of the Magmatic Differentiation of Igneous Rocks" (in the Academy of Science at Oslo), we may explain the formation of the ore magmas under consideration here by a subsidence of the *first* crystallizing minerals and a later *resorption at various stages (fractional* or *selective)* of the subsiding minerals.

To illustrate this we choose as an example an olivine gabbro consisting of 0.6 per cent apatite; 4.4 per cent titanomagnetite; 20 per cent olivine; 20 per cent diallage; and 55 per cent labradorite.

The crystallization at the various early stages of the cooling may be illustrated by the following table:

	Quantity of the Separated Minerals Per Cent	Apatite Per Cent	Ti-magnetite Per Cent	Fe, Mg-sil. (Olivine) Per Cent	Percentage Relation Between the Separated Minerals: Apatite	Ti-Magnetite	Fe-Mg-sil. (Olivine)
I.	0.1	0.1	....	....	100	....	..
II.	0.5	0.2	0.3	....	40	60	..
III.	1	0.3	0.7	....	30	70	..
IV.	2	0.4	1.6	....	20	80	..
V.	3	0.45	2.3	0.25	15	77	8
VI.	4	0.5	2.5	1.0	12.5	62.5	25
VII.	5	0.52	2.88	1.6	10.4	57.6	32
VIII.	10	0.55	3.45	6	5.5	34.5	60

The mixture of the separated minerals consists, at the very first stage, of apatite alone (or apatite with a little zircon, etc.); at the next following stages, of apatite and titanomagnetite, the mixture at the most of these stages carrying much more iron-ore mineral

[4]As to the detailed arguments see my papers, "Die Sulfid-Silikatschmelzlösungen" (Norsk Geologisk Tidsskrift, IV, 1917), the chapter in *Journ. of Geol.* Vol. XXIX, 1921, p, 636-645, and "Nickel in Igneous Rocks," *Econ. Geol.* Vol. XVIII, 1923.

[5]See T. S. Lovering, "Magmatic Chalcopyrite," Park County, Montana (*Econ. Geol.* Vol. XIX, 1924, p. 636) and the papers by other investigators there quoted.

[6]As to the geology of these deposits see the detailed descriptions, especially by P. Geijer. As to their formation by the same kind of process which produced the titaniferous deposits, Taberg, Rautivare, and others, in gabbros, etc., I refer to a paper by myself, to be printed in *Geol. Fören*, Förh, Stockholm, 1927.

[7]See Beyschlag, Krusch, and Vogt, Die Erzlagerstätten, I, (first edit. 1910, second edit. 1914, p. 291-293). The banded quartz magnetite deposits at Lofoten-Vesteraalen and Sydvaranger) (Part I, 1914, p. 293-298) I originally considered as magmatic segregation. This interpretation can, however, no longer be retained.

[8]Indeed, we may here make a reservation as to the anorthosites.

than apatite; and at the subsequent stages, of apatite (in decreasing quantity), and magnetite and ferromagnesian silicate (in increasing quantity).

The ordinary proto-enriched dikes—in the main identical with Rosenbusch's lamprophyric and Brögger's melanocratic dikes—may be explained by (fractional) resorption of (1—n) parts of mixtures equaling the above stages V-VIII (or a still further stage) in n parts of the mother magma, where n may vary from about 0.95 or 0.9 to about 0.5-0.4. Rocks such as the titanomagnetite or ilmenite-gabbros-norites, etc., may be explained by a (fractional) resorption of (1—n) parts of mixtures equaling the stages VI-VIII in n parts of the mother rock, where n = about 0.4-0.3 or 0.25. Rocks such as the titanomagnetite—or ilmenite-olivinites, hypersthenites, or diallagites—may be explained by a (fractional) resorption of the mixtures V-VIII and n = 0.2, 0.15, 0.1 or still less. And the almost pure concentrations of iron ore, besides more or less apatite and only a trifle of silicates, especially ferromagnesian silicates, may be explained by a (fractional) resorption of the mixtures II-IV or V in only a trifle of the original mother magma, this trifle occasionally approaching zero. In such cases we may speak of a remelting, rather than of a resorption.

In the new-formed magmas resulting from a (fractional) resorption of the subsiding minerals we may get the physicochemical conditions for the formation of new minerals, such as spinel (pleonaste) and corundum, belonging to the very first stages of crystallization. The subsidence of these new-formed minerals may explain the occurrence of spinel (pleonaste) and corundum, especially the first one, often present in a rather great quantity in the titaniferous iron ores.

As for the nelsonites proper—rutile nelsonite, ilmenite nelsonite, and titanomagnetite nelsonite—with 20-30 and sometimes even about 40 per cent apatite, we may presume a subsidence of mixtures such as II-IV, n approaching zero, and further an almost contemporary resorption of the subsiding apatite and iron-ore mineral (or in some cases rutile).

Also, some of the ordinary titaniferous iron-ore rocks not only in divers syenites, but also in gabbros, carry very high contents of apatite, such as 15, 20, 25 per cent and in places still more. But most of these ore rocks or ore deposits carry only very small contents of apatite, occasionally even down to 0.08 per cent apatite (= 0.015 per cent phosphorus). At the subsidence of the first crystallizing minerals the apatite—occurring in rather small crystals and with a rather low density—in these cases may have been separately resorbed, at an earlier stage than the iron-ore mineral. And in general we may presume that the subsiding minerals in most cases have not been resorbed contemporarily, but at various stages (*fractional* or *selective* resorption).

As to the great, and at some places (Kiirunavaara) even gigantic iron-ore deposits in northern Sweden, due to an intrusion from a very great depth of an ore magma, we give some figures.

		Average Composition, Per Cent					
	Area m²	Magnetite (Hematite)	Apatite	Silicate, Etc.	Fe	P	MgO
Kiirunavaara	329.000	88	8–8.5	3.5–4	62–63	ab. 1.5	0.6–1.0
Gellivare	220.000	90	ca. 4.5	5–6	63–64	ab. 0.8	0.7–1.2
Tuollavaara	15.000	92.5	1.1	6.5	ab. 66	ab. 0.2	1.8–2.3
Mertainen	10.000	ab. 89	0.5–0.8	ab. 10	ab. 63	0.1–0.15	(3–3.5)

Note: ca. and ab. = approximately.

Further on the average:

0.2–0.45 per cent TiO_2 0.15–0.20 per cent MnO
0.15 per cent V_2O_3 (!) 0.01–0.04 per cent S, trace Ni

The predominating silicates are hornblende and augite: thus ferromagnesian silicates in the same manner as at the gabbroidic deposits.

Taking Kiirunavaara as an example, some great parts of the orebody carry only a trifling quantity of apatite (= 0.03, 0.02, 0.01, in places even less than 0.01 per cent phosphorus): other parts carry an intermediate or a rather low quantity of apatite (ore classes with 0.04-0.10 per cent phosphorus, equaling 0.2-0.5 per cent apatite, being only rarely present); and as the other extreme, large portions carry a very high admixture, such as 15, 20, 25 per cent and even still more of apatite. Also, this fact may be explained by a fractional or separate resorption of the subsiding apatite, and the injected ore magma consisted—as stated by Geijer—of more partial ore magmas, with highly varying contents of the phosphate. The quantity of the class of ore which contains only a triflng percentage of apatite increases with depth; this may be explained by the fact that this class of magma is denser than the type of ore which is very rich in dissolved phosphate.

The new-formed titaniferous iron-ore magmas in the gabbros, etc., were in general almost "dry" magmas, carrying only a small quantity of dissolved light volatile compound. The new-formed iron-ore magmas of the Kiruna type originated at a very great depth—many, say 10 or 15, kilometers, below the original surface—within a rather acid magma (with about 70 per cent silica); this ore magma contained, on the other hand, a rather high quantity of volatile compounds, especially H_2O and CO_2. At some localities, especially at Gellivare, we meet with minerals such as scapolite and fluorite in a rather subordinate quantity, proving also that some chlorine and fluorine were present in the gases escaping from the ore magmas. At other localities, with Kiirunavaara-Luossavaara as the best-known example, minerals such as scapolite and fluorite are completely lacking (or not yet observed), the quantity of the halogens not exceeding the amount entering into the fluorine-apatite (with a trifling quantity of chlorine). Therefore, the gases dissolved in the ore magma contained at some places rather small contents of dissolved halogen compounds and at other places practically no halogen compounds.

As to an attempt to explain in detail the formation of the *platinum* deposits within the peridotites, I refer to a paper by myself sent some time ago to *Economic Geology* for publication.

III

Due to the Concentration Within the Residual Magma

I quote from Spurr:[9]

"Vogt admits as magmatic segregations almost exclusively ores connected with basic rocks, considering the ores as among the first minerals to crystallize . . . I [Spurr] have always been fascinated by the extremely siliceous igneous rocks—granites, quartz feldspar rocks or alaskites, pegmatites, quartz dikes, and related quartz veins. Certainly, however, these siliceous extremes are as truly magmatic as the basic extremes."

Spurr may here in the main be right. I have in papers from the 90's, and later especially, treated the above-mentioned two classes of ore magmas, neglecting ore magmas formed in connection with the residual magmas.

[9] *Econ. Geol.*, Vol. XVIII, 1923, p. 626 and recapitulated in his discussion paper in *Trans.* A.I.M.E., 1926, and *E. & M. J.*, July 24, 1926, Vol. 122, No. 4, pp. 134-140.

It is my opinion Spurr's merit that he has called attention to the significance of the residual magmas as a source for ore magmas.

Let me begin with some remarks concerning the *pegmatites*, in Norway very frequently connected with many—but not with all—fields of granite; further, with many fields of gabbros or norite, at Langesundsfjord and Fredriksvern with nephelite, or augite-syenite (studied in detail by W. C. Brögger, 1890), occasionally also with still other rocks. It has long ago been assumed that the pegmatites represent residual magmas within the respective mother magmas. As decisive arguments in favor of this conclusion I point out the following fact: The mixcrystal minerals, such as plagioclase and the ferromagnesian silicates (composed of one or more high-melting components which at crystallization are concentrated in the *first* separated individuals, and of one or more low-melting components which at crystallization are concentrated in the *last* separated individuals) of the pegmatites show, compared with the same minerals of the mother rock, a remarkable decrease of the high-melting components and a corresponding remarkable increase of the low-melting components[10].

Referring to a lecture (given on April 16, 1920) by the Norwegian State Geologist, Th. Vogt, in the Academy of Science at Oslo, I further point out the difference as to the texture of the dikes of the residual magmas, but formed at varying depths, and thus, also, at varying pressures. In deep-seated magmas—for example, within the nordmarkite north of Oslo, solidified at a relatively low depth or pressure (and with a microlitic texture)—the residual-magma dikes are characterized by a fine-grained (porphyritic, granophyric, aplitic) texture. In deep-seated rocks, solidified at a very great depth or pressure (and without a microlitic texture) the residual-magma dikes, on the other hand, are characterized by a pegmatitic texture. Indeed, we know transition stages, but we have enough observations to conclude that the *pegmatitic texture presumes a formation at very considerable depth or pressure.*

In the deep-seated magmas solidified at a relatively low pressure, the escape of the originally dissolved light volatile compounds (H_2O, CO_2, etc.) kept pace with the solidification, and they were consequently not—or were only quite subordinately—concentrated into the residual magma. In the deep-seated magmas solidified at a very high pressure we meet with an opposite manner of proceeding, the light volatile compounds here being concentrated within the residual magma. The contents of the light volatile compounds make the magma very thin and fluid, and this again must be the cause of the formation of very great individual crystals[11].

As to the conditions decisive for the formation of the pegmatites, I differ from Spurr as well as from Lindgren on some points. Spurr is of the opinion that the pegmatites "develop only if the time for differentiation is sufficient." It is, however, not time, but a very high pressure, causing high contents of light volatile compounds, and for this reason a great thinness, which is the decisive factor. And Lindgren writes that "pegmatites are a normal accompaniment of the consolidation of acidic rocks whether abyssal or intrusive near the surface." The pegmatites are, however, accompanying not only acidic but also intermediary and basic rocks, even gabbros with about 50 per cent silica, and peridotites with only about 40 per cent silica, but they are lacking in intrusives near the surface.

In several papers of recent date we find terms such as the "pegmatitic magma" or the "pegmatitic juice" used for the residual magmas in general. This is, however, not correct. The pegmatites are, indeed, residual magmas, but only in abyssal magmas, solidified at an extraordinarily great pressure.

Within the Archean granite at Fredrikshald-Fredriksstad-Hvaloërne (southeastern Norway) and further within the Devonian augite syenite near Fredriksvern and the nephelite syenite at Langesundsfjord, where the pegmatites in the main—but far from exclusively—occur almost *in situ*, I have estimated, or at some places measured, the quantity of the pegmatites, which amounts to 0.5, 1, or in places about 2 per cent in relation to the mother rock.

The composition of the pegmatites within the same rock depends in the main on two different factors:

(1). At the solidification of the mother magma we get in the residual magma an enrichment of the components belonging to the latest stage of the crystallization.

(2). The light volatile compounds such as H_2O, CO_2, HF, HCl, H_2S, etc., originally dissolved in the mother magma, were to a certain extent concentrated in the residual magma; and, further, these compounds, continuously acting upon the mother magma, caused—to use a term which I proposed many years ago (1895)—an "acid extraction," bringing over a lot of compounds originally combined with silica, etc., into volatile compounds, such as B Cl_3, B F_3, Sn Cl_4, Sn F_4, Mo Cl_5, Mo O F_4, Mo Fe_6, Nb Cl_5, Nb F_5, Be Cl_2, Be F_2, etc.[12]. The mixture of the volatile compounds, dissolved in the magma and during the solidification, at a very high pressure, enriched in the residual magma, may here give rise to the formation of new combinations.

In accordance with these views we point out some chemical and mineralogical features characterizing the pegmatites, with special reference to the granite pegmatites.

(1) As already mentioned, the percentage of the (high-melting) MgO-components in the ferromagnesian silicates and of the (high-melting) An-component ($Ca\,Al_2\,Si_2O_8$) of the plagioclase—or of the feldspars in general—is rather low. Compounds such as Cr_2O_3 and NiO, which at the crystallization (and the magmatic differentiation) were strongly concentrated into the first crystallizing minerals[13], are practically entirely absent in the pegmatites. These carry also in most cases only a very small admixture of phosphates, some exceptions being due to a supply owing to the agency of the light volatile compounds.

---

[10]See my papers, "Die physikalisch-chemischen Gesetze der magmatischen Differentiation" (Oslo Acad., 1924, p. 6, 19), and "The Physical Chemistry of the Magmatic Differentiation of Igneous Rocks" (Oslo Acad., No. I, 1924, p. 101-109 and No. II, p. 15-19, p. 39-40 and p. 90; further, the future No. III of the same series.)

[11]Referring to my paper in *Journ. of Geol.* Vol. XXXI, 1923, p. 239-246. I emphasize that the rate of crystallization is a function of several factors, and one of the most important of these is the *degree of viscosity*. At one atmosphere pressure the rate of crystallization of many silicate minerals, by the segregation from *very thin* melts, is on an average 1 mm. per minute or 3 cm. per half hour. Also, the artificial melts (furnace slags) at one atmosphere pressure dissolve some gas, but only in a trifling quantity, without affecting the viscosity.

[12]I refer to the tables comprising the melting point, the boiling point (at the pressure of one atmosphere) and the critical temperature of some substances, which I have collocated in *Econ. Geol.*, Vol. II, 1926, p. 217 and 218.

[13]For nickel see my paper "Nickel in Igneous Rocks" (*Econ. Geol.* Vol. XVIII, 1923) and for chromium "The Physical Chemistry of the Magmatic Differentiation of Igneous Rocks" (Vol. I, 1924), and many earlier publications.

(2) On the other hand, compounds which at the solidification of the mother magma were not concentrated into the first separated minerals, might of course be concentrated into the residual magma. I refer to the relatively high percentage of the iron oxides in the ferromagnesian silicates, and of MnO in divers silicates (garnet, mica, etc.); further, to the contents, indeed rather small, of PbO, ZnO, etc., in divers minerals of the pegmatites. As to gold, see the comment in a succeeding paragraph.

(3) In many Norwegian granite pegmatites, tourmaline is completely or almost completely lacking; on the other hand, in other dikes the mineral is present in great abundance. In general[14] I point out that the *considerable quantity* of one or several of the elements Sn, W, Mo, U, Li, Be, Y, Ce, P, etc., in some special granite pegmatite dikes, compared with the commonly low percentage or almost complete lack of the same elements in most dikes, cannot be explained by the "normal" slight enrichment of the residual magma by compounds not (or only subordinately) entering into the first crystallizing minerals. On the contrary, this phenomenon must depend on an *extraordinary* supply, in one dike of Sn, in another of Mo, etc., due to the just-mentioned magmatic extraction by the light volatile compounds. Further, I note that this extraction, giving so highly varying results, may be a very subtile process: even small variations as to the proportion between the agencies H_2O, CO_2, H Cl, HF, etc., and as to pressure, temperature, etc., causing a complete dislocation of the chemical results.

(4) The pegmatites indeed often carry some sulphides, especially pyrite; but, on the whole, the admixture of the sulphides of iron, copper, zinc, lead, etc., as a rule is very subordinate. Molybdenite here forms an exception. As to the *temperature interval*[15] of solidification, I call attention to the fact that the granites, among all the most ordinary kinds of rocks (contrary to what was often supposed previously), are those which have solidified at the *lowest* temperature. The decrease of the temperature interval due to the dissolved gases (or light volatile compounds) more than balances the increase due to the pressure (Th. Vogt). Therefore, the "granitic" effusives as a rule are solidified at a higher temperature than the corresponding deep-seated magmas at a rather shallow depth, say about 1 kilometer, and these again at a higher temperature than the corresponding magmas at a very great depth, say 5 or 10 kilometers.

According to the determination of several mineralogists, the quartz of the graphic granite of the granite pegmatites in an α-quartz (high-temperature quartz) crystallized at a temperature above the inversion point between α- and β-quartz, 575 deg. plus some increase due to pressure, thus about 600-625[16]. The minerals of the granite pegmatites, separated at a still earlier stage than the graphic granite, must have been formed at a still somewhat higher temperature. The younger masses (including dikes, veins or veindikes) of quartz, intimately connected with the granite pegmatites, consist on the other hand—in the main, exclusively—of β-quartz, crystallized at a lower temperature than the inversion point just named.

The solidification of the granite magma at a great depth may have begun at about 900-950 deg. and finished say at about 750 deg. Then began the solidification of the pegmatitic residual magma, present in a quantity of some 1 or 2 per cent, and most of the pegmatite minerals crystallized at a temperature from say 750 deg. to 600-625 deg., or somewhat above 600-625 deg.

And then followed the separated masses of quartz, intimately connected with the granite pegmatites and exclusively or in the main consisting of β-quartz, solidified at a temperature below 600-625 deg., the last residual of these masses very rich in H_2O, etc., probably even at a temperature rather far below 600 deg.

Referring to an investigation of J. Jacob (Zürich) and to several other investigations, collocated in my paper in *Economic Geology*, Vol. XXI, 1926, pp. 230-231, we may conclude that the masses of quartz in question were solidified, not from a solution consisting of the components SiO_2 and H_2O, but from a solution consisting of SiO_2, n H_2O, or H_2 SiO_3, n H_2O (where n may be 0, 1, 2, or a still higher figure). Also, this solution may be considered as a magma, and in this magma it is possible that many of the volatile compounds may have been concentrated.

In the above explanation I have given my arguments for agreeing with Spurr's use of the term "quartz-magma" for the special masses of low-temperature quartz, occurring partly as veins, dikes, or veindikes, and intimately connected with the granite pegmatite. But at the same time I warn against the generalization that all veins, etc., of quartz must have been formed in this manner.

Agreeing with Spurr's statements, that the *gold quartz* in some districts, very deeply denuded, is intimately connected with granite pegmatites, and that the occurrence of this kind of gold quartz as veindike demonstrates an intrusive formation, I believe that Spurr is right in considering this kind of gold quartz as a magma, this term being used with the limitation which I have given above. Indeed, I could wish that the gradual transition from granite pegmatite to gold quartz had been determined by a detailed series of competently conducted petrographical and chemical investigations.

As is well known, the *platinum* metals are almost exclusively connected with very *basic* rocks, especially peridotites, whereas *gold*, on the other hand, in the main is connected with *rather acid* rocks. Referring to my paper "Magmas and Igneous Rocks" (in *Economic Geology*, Vol. XXI, Nos. 3, 4 and 5, 1926) and to a paper, "The Geology of the Platinum Metals" (sent to *Economic Geology* for publication) this remarkable difference may be explained in the following manner: The platinum metals and gold, owing to their very slight tendency to form chemical compounds, may in the original common magma of the magma basins have existed in the main as dissolved metals. At the period of magmatic differentiation, the platinum metals, owing to their limited solubility and their high melting points (for platinum, 1,755 deg.), were to a very great extent separated (as metals) at the first stages of the gravitative differentiation, and were continuously concentrated in the proto-enriched rocks, with the peridotites as the extreme results. Gold, on the other hand, owing to its much lower melting point (1,063 deg.) could at the previous stages of the magmatic differentiation not be separated in the solid phase, and was for this reason gradually enriched in the residual magmas which gave rise to the acid or rather

[14] See the review in my paper in *Econ. Geol.*, Vol. XXI, 1926, p. 225-228.
[15] See *Journ. of Geol.* Vol. XXXI, 1923, p. 407-419 and other papers.
[16] *Journ. of Geol.*, Vol. XXX, 1922, p. 619 *et seq.*

acid rocks. Since the intimate connection of gold with quartz indicates a rather great solubility of gold in solutions very rich in silica, we may get a concentration of gold in the residual silica magma, representing the final stage of the differentiation in the silica direction.

I presume that future investigations will prove more classes of ore deposits to have been formed as residual ore magma, with the limitation of the term "magma" given heretofore. I may, however, point out that in each case detailed geological and petrographical arguments should be presented as the basis for the genetic conclusion.

Spurr has seized hold of an idea which in principle, in my opinion, is correct. But he is one-sided; thus he practically takes no regard to the above first-mentioned two geological classes of formation of ore magmas, and he in my opinion extends his doctrine to things quite outside its province.

(To be concluded in the April 23 issue)

World's Sheet Mica Mostly from British India

India produces 65 to 70 per cent of the world's supply of sheet mica, obtained from mines located principally in the Hazeribagh district in the Province of Bihar and Orissa, about 250 miles from Calcutta, which is the principal port of shipment, says Consul William L. Jenkins, of Calcutta, in a recent issue of *Commerce Reports*.

The mica district in Bihar is a strip of country about 12 miles wide and 60 to 70 miles long. The town of Kodarma is the mining center of this district. The other mica center in India is in the Nellore district of the Madras Presidency, but the mica mined in this area amounts to less than one-third of the amount mined in the Hazeribagh district.

After trimming and grading, the mica is sorted according to size, which, as arbitrarily set in the Indian industry, conforms in general to gradings of mica in other countries. The classification is according to the number of square inches in the single sheet from the block, and starts with "extra special," containing from 60 to 70 square inches, followed by "special," "A1," and six numbered grades, the last containing only one to three square inches in the sheet. For export it is packed in paper-lined cases containing 100 lb. of mica of a uniform size and quality.

The following table gives the exports of mica from British India during the fiscal years ended March 31, 1924, 1925, and 1926, respectively, with the principal importing countries.

Exports of Mica from British India

(In English hundredweights of 112 pounds)

Country of Destination	1923–24	1924–25	1925–26
United States	47,251	33,815	43,230
United Kingdom	20,584	34,008	31,639
France	1,634	945	1,304
Germany	5,649	8,837	13,398
Others	3,830	4,642	6,885
Totals	78,948	82,247	96,456

The 1923-24 shipments were valued at 8,636,911 rupees, those of 1924-25 at 10,270,619, and those of 1925-26 at 10,416,815. (The rupee exchanged at about $0.31, $0.32, and $0.36, respectively, during the three years.)

A list of mica producers, dealers, and exporters in British India, who are not represented by branch offices in the United States, is on file in the Minerals Division of the U. S. Department of Commerce, at Washington, and will be made available for examination to interested parties. These names were furnished by the American Consul General at Calcutta. American consular officers in any foreign city will on request furnish similar lists directly to any American person or firm interested.

Development and Exploration at the Hollinger Mine

At the Hollinger mine a series of gold veins is under development and exploration simultaneously with the production of 1,930,158 tons of ore or thereabouts per annum. The veins vary in width and value, but generally fall into the division of relatively narrow workings. The extent of the work contemporaneous with mining is not often fully realized, but in this instance the annual footage of sinking, drifting, crosscutting, and raising aggregated 83,326 ft., or almost 16 miles. Ore production is at the rate of 23.1 tons per foot of development. The ratio is roughly estimated at 10 cu.ft. of ore per cubic foot of development.

The detailed figures are of interest. Shafts aggregate 2,334 ft.; drifts, 35,571 ft.; crosscuts, 44,851 ft., and raises, 570 ft. This work was distributed upon 23 levels and within a vertical range of 100 to 3,200 ft. In addition, diamond drilling aggregated 115,017 ft.

To maintain an ore production of close to 2,000,000 tons per annum, Hollinger reports 4,992,929 tons of ore in reserve; 80,280 tons in surface outcrops, and 2,706,025 tons of probable ore; a total of 7,779,239 tons. The estimated gross value of this reserve and probable is stated in the annual report to be $66,081,733. Thus, setting aside probable ore, Hollinger maintains reserves of about two and one-half times the annual production. During 1926 production averaged 5,295 tons per day. The average value was $7.99 per ton. Mining costs, excluding overhead, were $2.63 per ton and included no doubt development and exploration.

The labor figures are also of interest; the average number employed in the year was 2,482, divided into 1,571 miners, 374 mechanics, and 537 general. The over-all ratio is 777 tons per annum per man employed.

Hollinger is in fact a number of mines under one management and keyed into a general development plan. The economic results are no doubt influenced in large degree by this arrangement and would be entirely different were a number of separate properties operated.

Coarse Tailing Reserves in the Tri-State District

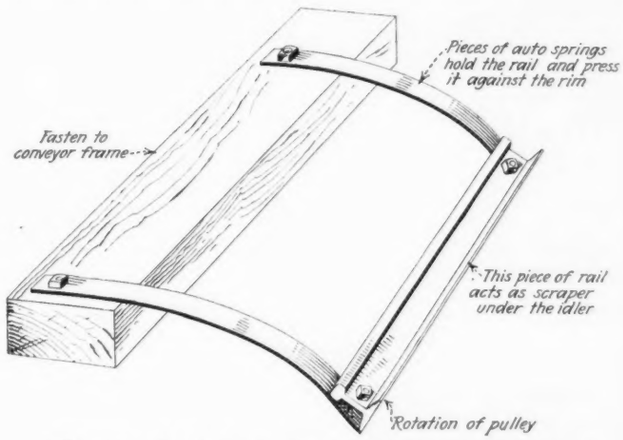
A typographical error is acknowledged in Mr. Keiser's article, "Re-treating Coarse Tailing in the Tri-State District," which appeared in the April 9 issue of *Engineering and Mining Journal*. The first three lines in the second column on page 600 should read, "An estimate based on the production records of the field indicates that 50,000,000 tons of coarse tailings are available for re-treatment."

Useful Operating Ideas

Scraper for Conveyor Pulley

By Charles Labbe
Clarkdale, Ariz.

In wet weather it will be found that much fine material adheres to conveyor belts and also to the larger idler pulleys of the return belt, causing in a short time objectionable accumulations. To get rid of this material


Pieces of auto springs hold the rail and press it against the rim
Fasten to conveyor frame
This piece of rail acts as scraper under the idler
Rotation of pulley

Scraper devised to keep conveyor pulley clean

scrapers are usually placed at the first large idler. The simplest scraper within my experience is made of a piece of light rail weighing from 8 to 12 lb., of the same length as the face of the pulley and pressing very lightly against the rim by means of two pieces of discarded auto spring. At each end the rail is bolted to the spring, and this in turn is fastened to the conveyor frame by lagscrews or bolts as indicated in the accompanying figure. The springs keep the scraper against the pulley's rim without further adjustment.

Experiments With Dust-Catching Devices

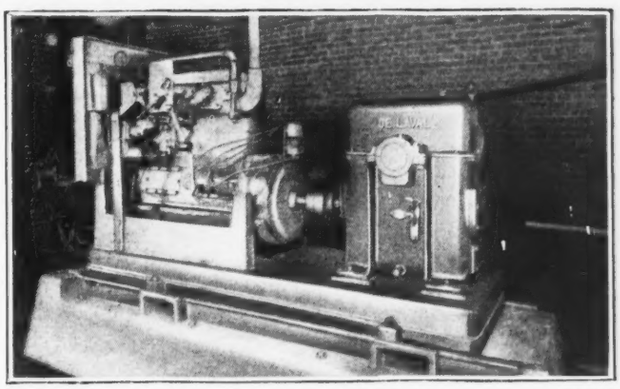
In the November, 1926, issue of *The Journal of the Chemical, Metallurgical and Mining Society of South Africa*, A. Mavrogordato describes experiments conducted with devices designed to remove rock dust arising from drilling operations, and where it is desirable not to use water. A hood designed to be fitted about the drill steel and supported by telescopic rods attached to the cradle of the drill formed a partial closure at the collar of the drill hole. Air was drawn from this through a filter consisting of a layer of coke and about 10 in. of wet sawdust and then passed to the ejector, which was first operated by the drill exhaust and later by high-pressure air. It was found necessary to draw about 200 cu.ft. per minute through the hood. The hood does not form a tight connection about the drill hole, but allows sufficient air to flow into the openings from the outside to move the dust to the filter. Under the experimental conditions, as good conditions were obtained in drilling dry by the use of the hood, filter, and ejector when "collaring" a hole as when collaring in drilling wet. The device is in its experimental stages, but it offers promise of further development.

Emergency Drive for Mine Fans

Although electricity offers economy and convenience in the operation of mining machinery, including pumps, fans, drills, hoists, and haulage equipment, it has one objection in that the supply may at times be interrupted. This is sometimes serious in the case of fans, since the lives of the men and the safety of the mine may depend on a continuous, uninterrupted supply of a certain minimum of fresh air.

The accompanying illustration shows how an internal-combustion engine can be applied as a stand-by, or emergency, drive. Mine fans handle large volumes against low pressure and therefore run at slow speed, whereas gasoline engines run at speeds of 1,000 r.p.m. or more, so that it is necessary to employ some means of speed transformation. In the illustration the fan is inclosed within a brick chamber and is normally driven by an electric motor. As it would be impracticable to use a pulley small enough to give the speed-reduction ratio from the 1,200 r.p.m. to the fan speed, a worm reduction gear of $3\frac{5}{9}$ to 1 ratio is made a part of the stand-by unit, an overhung pulley being mounted directly upon the worm-gear shaft.

When it is desired to use the engine drive, the belt connecting the electric motor to the fan pulley is thrown off, and another and shorter belt is run on to the fan and gear pulleys. For tightening this belt, the cast-iron

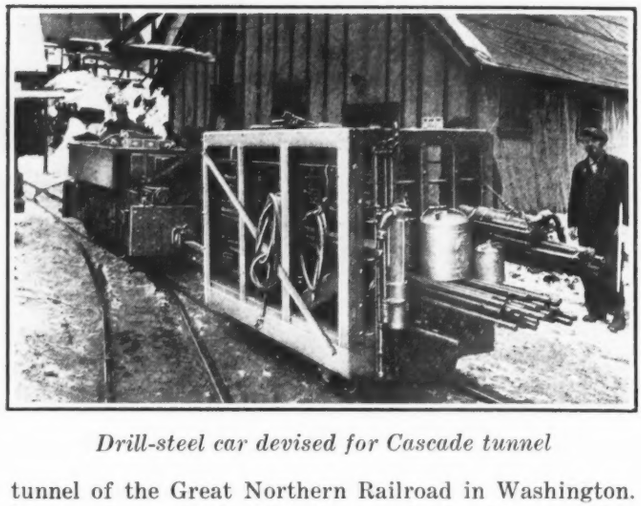


Applying an internal-combustion engine as a stand-by, or emergency, drive from mine fans

bedplate of the driving unit is mounted upon slide rails which are cast into the concrete base, and adjusting screws at the far end of the bedplate are used for drawing up on the belt. This arrangement has worked satisfactorily, although for convenience in starting the unit it would have been better had a clutch been inserted between the engine shaft and the worm shaft of the reduction gear. The form of drive described was designed and installed by Charles M. Means, consulting engineer, Pittsburgh, Pa.

Drill-Steel Car for Tunnel Work

In most adit and tunnel work drill steel required at the working faces is loaded into special cars and hauled to the point of use. Usually no effort is made to segregate sizes. An improvement on this practice was noted in a special drill-steel car used in driving the Cascade



Drill-steel car devised for Cascade tunnel

tunnel of the Great Northern Railroad in Washington. The car is provided with a frame of 4 by 4-in. uprights with 1-in. steel bars which serve as racks for the drill steel, which is segregated with respect to lengths and bit sizes. The car provides four tiers, five racks high. Hooks are also provided at the ends of the car for the rock drills, which are shown in the accompanying illustration.

Heavy Liquids for Mineralogical Analyses

For the laboratory study of ores, Technical Paper 381 of the U. S. Bureau of Mines states that only two heavy liquids are usually necessary. Acetylene tetrabromide is recommended for all low-gravity work. Many ores contain quartz or calcite as gangue, and acetylene tetrabromide has a high enough gravity to float free a gangue composed of either of these minerals. As many ores contain more gangue than valuable minerals, the use of acetylene tetrabromide is recommended because it will remove the larger part of the sample; the smaller remaining part may then be treated with a more expensive, heavier liquid.

The most suitable liquid for sink-and-float work on minerals of high specific gravity is a water solution of the double thallous formate-malonate. This double salt, with a specific gravity of 4.9, melts at 60 deg. C. and is miscible in all proportions with water. At room temperatures the salt is soluble enough to give a solution with a specific gravity of nearly 4.3. As a liquid of intermediate gravity, an aqueous solution of thallous formate is recommended. It is less expensive than the formate-malonate. A maximum specific gravity of about 3.5 is reached at room temperatures, and gravities up to 4.95, the gravity of the molten salt, may be obtained.

Because of cheapness and desirable properties, acetylene tetrabromide diluted with carbon tetrachloride is recommended for gravities of 2.95 and below; because of its cheapness compared with the malonate-formate, thallous formate solution is recommended for gravities from 2.95 to 3.5; and the malonate-formate solution is recommended for gravities above 3.5.

Estimation of Thermal Expansion

By W. F. Schaphorst

Power engineers and others will find the accompanying chart useful for determining the expansion to be allowed in piping, rods and tubes for various temperature differences. To use the chart, simply lay a straightedge across it or stretch a fine black thread across, as indicated by the dotted line.

For example let it be assumed that a certain pipe line is installed which is 100 ft. long. It will be subjected to a temperature variation of 100 deg. F. What will be the total expansion in inches?

Connect the 100-deg. temperature difference, Column *A*, with the 100-ft. length, Column *C*. The intersection with Column *B* gives the answer as 0.8 in.

Conversely the chart can be used for determining the allowable temperature difference where a definite amount of space is available for expansion and contraction. Thus if the length of the pipe is 100 ft. and the allowable expansion is 0.8 in., the same line would show that a temperature difference of 100 deg. F. would be the limiting amount. Also, if the factors in columns *A* and *B* are known, the unknown in Column *C* is immediately found.

In other words, if any two of the factors are known, the third is quickly found, and without computation.

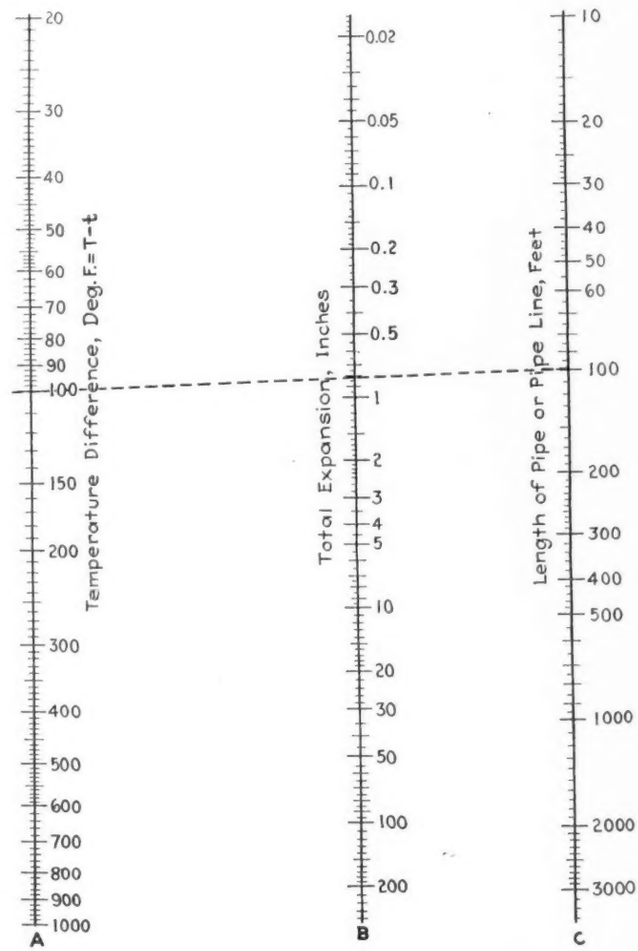


Chart for determining thermal expansion of pipes and rods

Consultation

Guggenheim Nitrate Process

"An article recently published in the *New York Times* stated that the Guggenheim interests in Chile have perfected a process for extracting nitrate from earth that heretofore has been too lean for successful treatment. Can you give me any particulars concerning the process?"

The following material is from an authoritative statement made by engineers connected with the Guggenheim interests, and naturally reflects the Guggenheim view of the situation:

A detailed study of the nitrate industry in Chile brings out four important points of weakness in the present technology. They are:

First—The process demands a raw material not under 15 per cent sodium nitrate to be profitably workable, and, consequently, as the average grade does not greatly exceed this figure, the expensive hand mining and sorting methods at present in vogue become almost a necessity.

It is true that in a number of cases mechanical drilling has been subtituted for hand drilling, and this is undoubtedly a step in the right direction, but only a small percentage of the high labor cost is thereby avoided and nothing is accomplished thereby in avoiding the heavy losses in the mining operation. The application of mechanical methods of mining such as mechanical shovels at various times has been suggested and attempted, but has usually broken down, due to the fact that inevitably the grade of the material has fallen below the economic limit.

It has been variously estimated that, of the total nitrate in the caliche broken, from 15 to 25 per cent is left in the field without any attempt being made to transport it to the recovery plant.

Second—The method as at present employed throws into the atmosphere every single calorie of heat which enters into the process, either through radiation from the uninsulated tanks during the boiling operations, through dissipation of the heat contained in the tailings passed hot to the ripio dump, or through the loss during the crystallization in the open, no attempt being made in any case to recover and re-use any of this heat.

Third—Due to the violent agitation to which the material is subjected during the boiling operation, and also to the temporary solution of the sodium sulphate and the complete solution of the sodium nitrate, the physical structure of the caliche is completely destroyed and there remains at the time the washing cycle is begun an almost impermeable mass, making efficient washing an impossibility. But efficient washing is an essential in any effective leaching process.

Fourth—The industry is based on small unit operation, there being some 150 plants, with a total maximum capacity of 3,500,000 tons of product. Consequently the savings due to large-scale operation cannot be attained, and it is extremely doubtful, in view of the mining method employed, whether large-scale operations would be feasible in any event.

In order to overcome these weaknesses the development of a radically different treatment method is the prime essential, as only thereby can the other ends be attained.

It is approximately from this basis that the development of the Guggenheim process for the recovery of Chilean nitrate was started about ten years ago. A plant applying this process started operations in Chile on Nov. 22, 1926.

The problem was first attacked from the standpoint of providing a better recovery process. The advantages of leaching at or near atmospheric temperature as a means to avoid the difficulties in the leaching operations in the present practice were clear, and these benefits were further heightened in the minds of the investigators by their experience with the development of the leaching and recovery process for copper ores already in practice at the plant of the Chile Copper Co. situated at Chuquicamata, Chile.

As a temperature change is essential to cause crystallization, inevitably leaching under the conditions outlined involved artificial cooling or refrigeration as a means of recovering the nitrate from the leaching solutions, and consequently the program of investigation was started to develop a process for the recovery of nitrate by means of atmospheric leaching and refrigeration.

This cycle of operations seemed ideal to apply to the leaching of nitrate ores, because it lends itself to large-scale operations; the solutions and caliches need not be heated above the atmospheric temperature, and thus there are no great heat losses. The solution could percolate quietly through the charge without disintegrating the caliche and thus permit finer crushing and efficient washing of leached material.

Therefore, one of the first phases of the problem to be studied was the refrigeration of nitrate solutions derived from caliche at atmospheric temperatures. These solutions contain as their major constituents sodium chloride and sodium sulphate, as well as sodium nitrate, and on cooling it is found that only sodium nitrate deposits until a certain minimum temperature is reached. Below this temperature sulphate is precipitated along with the nitrate. It was thus found that by cooling caliche solutions, saturated at ordinary or atmospheric temperatures, about one-third of the nitrate content of the solution could be deposited free from other salts, and the refrigerated solution, impoverished in nitrate only, could be returned to the caliche to dissolve more nitrate.

The next step was to study leaching, using the refrigerated or impoverished solution, with the purpose of determining what extraction or recovery of nitrate could be made. These tests were designed to parallel in a small way the copper leaching operations at Chuquicamata; that is, a certain calculated volume of the impoverished solution was put on the charge at the top and an equivalent volume of saturated solution was expected to be withdrawn from the bottom. The first portion of this calculated volume of solution withdrawn from the bottom of the charge was fully saturated in nitrate, but unexpectedly the remaining portion was withdrawn having practically the same nitrate content as that applied at the top of the charge. The first washes put on the charge were likewise withdrawn at practically the same nitrate composition, but when the final and very much weaker washes were applied, and these followed by water, there was a sudden increase in their nitrate content.

These results were very perplexing, and the tests were repeated under various conditions to make certain that the partial leaching was not due to some physical cause, as for example rate of solution, rate of penetration of the particle, or channeling of the charge. But the main result was always the same—that is, a part of the nitrate was readily dissolved while the remainder was insoluble in the leach solutions and could only be dissolved by water or very much weaker solutions than the regular leach solution. From these weak solutions nitrate could not be recovered in the pure state by refrigeration.

This difficulty encountered in leaching caliche led to a physicochemical investigation, covering a period of several years, on the nature of caliche and the leach solutions. The result of this investigation showed that not only does there exist in some caliches a double salt of low solubility—sodium nitrate in combination with sodium sulphate—but that during leaching a part of the free sodium nitrate is rendered insoluble by combination with sulphates. This combination takes place because of the decomposition of certain double sulphates, potassium-calcium sulphate and magnesium-sodium sulphate, which were found to exist in nearly all caliches.

By further study it was found that if the potassium and

magnesium ions in the leach solutions were maintained at suitable concentrations, the double sulphate of potassium and calcium, as well as that of sodium and magnesium, could be prevented from decomposing and so prevent the formation of the insoluble sodium nitrate-sodium sulphate compound. These ions, magnesium and potassium, have been termed stabilizers, as they prevent the decomposition of the double sulphate compounds and so protect the nitrate from being converted to the insoluble nitrate-sulphate form.

The continuation of this work showed that if these stabilizing elements, potassium and magnesium, were maintained in the solution at concentrations in excess of those necessary merely to prevent the decomposition of the double sulphate, the compound, sodium nitrate-sodium sulphate, already existing in the caliche, would be decomposed, freeing the nitrate and tying up the sulphate with the stabilizing ion.

Need for Blending of Caliches

Fortunately, there are caliches in most all localities which contain excess salts of these stabilizing elements, so that by the proper mixing or blending of caliches—that is, caliches containing the nitrate-sulphate compound—with caliches containing excess of the stabilizing elements, the nitrate in all of the caliches can be rendered freely soluble in the leach solutions. Thus, by proper mixing of caliches and controlling of the stabilizing elements, saturated solutions and high recoveries can be and have been obtained without further difficulty.

It was also found that these stabilizing elements when maintained at these certain minimum concentrations in the solutions had the beneficial effect of permitting the solutions to be cooled to a much lower temperature without depositing sulphate with the nitrate.

The physicochemical investigation was concluded by studying the solubility, in solutions, of borates, iodates, and perchlorates, which are the minor salts present in caliches in almost negligible quantities.

There remained a further study of leaching operations to determine the most economical size of crushing, rate of leaching, washing cycle, and related data. Owing to the slimy nature of caliche, rapid percolation could only be obtained by screening out the finest particles, not more than 5 or 10 per cent of the total caliche. This slime-forming portion was treated separately in a filter plant.

Economy of Fuel in New Process

As has already been pointed out, one of the requirements of a new process is to lower the fuel consumption per unit of nitrate produced. In the leaching process just described no heat, direct from fuel, is added to the solutions, but the cold refrigerated solutions must be heated or warmed to the atmospheric temperature before being returned to the leaching vats. For the very reason that the leach solutions are used at or but little above atmospheric temperatures, a cold leaching process is an admirable one, because the solutions are capable of absorbing waste heat from other low-temperature sources. Thus the reheating of the leach solutions is brought about in three ways: First, the cold refrigerated solution returns to the leaching plant through a series of crystallizers counter current with the saturated solution from the leaching vats. The returning cold solution therefore furnishes a greater part of the total refrigeration required, and the warmer solution from the leaching plant transfers heat to the colder solution. The leach solution from the crystallizers is further heated by passing through the ammonia condensers. Thus practically all of the heat removed from the crystallizers by mechanical refrigeration (expansion of ammonia) is also transferred to the leach solutions. Finally, waste heat from the Diesel-engine power-plant, by means of suitable interchangers, is transferred to the leach solutions.

Accordingly all the heat—B.T.U.'s rather than sensible heat—that is needed to take care of losses from the top of the vats by radiation, and for dissolving the nitrate, is supplied from waste heat and the only fuel required is that to operate the power plant.

The final part of the development of the Guggenheim process consisted in the installation and operation of a 50-ton plant in Chile for large-scale demonstration purposes. Caliches from various parts of nitrate pampas have been treated, and the results show an extraction of better than 90 per cent and the salitre produced is around 96 per cent in purity.

"Mine-Run" Mica

"I note that you quote 'mine-run' mica from New Hampshire at $380 per ton. Can you give me some specifications for material that is referred to in this quotation?"

"Mine-run" mica consists of "books" only, free from schist, feldspar, scrap, and other foreign substance. The material has been through the cobbing shed and is ready for the cutting and splitting room.

As a rule the larger the books, the more valuable will be the run-of-mine product, though this will not always hold, because sometimes a large book when rifted will prove to be badly tangled and cross-grained, or cracked and badly stained, so that it turns out to be mostly scrap rather than sheet. On the other hand, a small book may turn out to be clear and free from cracks after the outside scale has been removed.

To be worth $380, run-of-mine would have to be of unusually good grade. Some producers market run-of-mine at from $100 to $150 per ton. As a matter of fact not a great deal of business is done in mine-run grades. The miner usually rifts or splits his mica, selling it in sheet form of various grades and sizes.

As is explained in our monthly market report, the sale of non-metallic minerals is usually based on specific negotiation between buyer and seller, either for a given lot or for periodic deliveries from a given mine that are presumed to be comparatively uniform. For that reason the prices quoted are in some instances more indicative of the general trend of the markets rather than of the price that any producer, in the same or another locality, can obtain.

Market for Kyanite and Dumortierite

"Can you tell me what market, if any, there is for kyanite and dumortierite?"

The industrial utilization of these minerals has not been established on a large scale to date, and definite markets therefore do not exist. A great deal of experimental work has been done in investigating the possibilities of these minerals, and their industrial use is just beginning to be appreciable. Large consumers own their own deposits, which are ample to satisfy their needs. The amount sold in the open market for experimental use has been so small comparatively that prices per ton have not been established. The largest consumers are the Champion Porcelain Co., of Detroit, Mich., which operates a deposit of andalusite, a mineral similar to kyanite, in California and a deposit of dumortierite in Nevada. The Vitrefrax Co., of Los Angeles, also operates a deposit of kyanite in California. Large tonnages are reported to be available in Wyoming, Virginia, and North Carolina, but to date little production has been made, owing to the limited demand.

Pyrites Quotations

"In the issue of March 5 you quoted pyrites at 13¾c. Please explain how to compute the price per ton. Do you know of any process for the separation of sulphur from pyrite ore on a commercial basis?"

The quotation on pyrites at 13¾c. per unit applies to the sulphur content of the ore. The basis is the long ton of 2,240 lb.; 22.4 lb. is the equivalent of one unit.

There is no process of which we know by which sulphur can be recovered from pyrite at a profit. Chemically, of course, it is feasible, but the cost is greater than the price of competitive products so that there is no industrial application of the process.

News of the Week

Summary

SECRETARY HOOVER says he will do all in his power to have federal aid rendered the mining industry in the matter of gathering and distributing information essential to the industry.

Aërial photography to the extent of 36,000 square miles of mineralized territory photographed is the 1926 record of the Canadian Topographic Surveys, working in co-operation with the Royal Air Force. The work is reported to have been of inestimable value in opening up new areas. The 6,000 claims which were recorded last season in the area east and southeast of the Red Lake region are said to have been the result of the data provided by the maps prepared from aërial photographs of this area.

Minister Morones, Department of Industry, of Mexico, takes exception to statements of mine operators from Sinaloa, in which, it is said, the operators claimed the present mining laws were injurious.

A new cause of fatal accidents has appeared in the Joplin-Miami district; slides of tailings at coarse tailing re-treatment mills have been responsible for two such accidents since the first of the year.

The Atlas Mining Co. completes 7,000-ft. crosscut tunnel near Mullan, Idaho.

Evidence, of the "no-one-can-deny" type, that milling operations have greatly improved in recent years, is seen in the many re-treatment operations now current in the industry. Recent dispatches report good recoveries from former mill tailings in the tin district of Cornwall, in the Michigan copper district, and in the zinc-lead field of the Joplin-Miami district.

The hardships of pioneer operators at Rouyn are fast disappearing; cabin airplanes for passenger and freight service are now in operation into the district. Prices on townsites in the North country are going up—Rouyn townsite recently sold for $500,000.

Canadian Aërial Maps Help Open Up New Fields

Topographical Surveys in Co-operation With the Royal Canadian Air Force Photograph 36,000 Square Miles of Mineralized Area in 1926

THE use of aërial photograghs in the mapping of the mineralized areas of Canada has been one of the most important applications made of aërial photography in the Dominion. During the season of 1926 over 36,000 square miles of such areas were photographed. For years the officers of the Topographical Surveys, Department of the Interior, in common with other survey organizations, have been hampered in their endeavors to map large areas, important from a mineral standpoint, because of the natural difficulties of the country and the consequent huge expenditures involved. It was only natural that, when through co-operation the facilities of the Royal Canadian Air Force were placed at the disposal of the Topographical Surveys, first efforts were directed toward the making of aërial maps. From the outset these efforts were successful, and the development of the work has been so rapid that huge areas of hitherto totally unmapped mineralized territory have been mapped with remarkable completeness.

The first aërial map of a mineral field to be issued was that of The Pas district in northern Manitoba. This so satisfactorily met the needs of prospectors and others interested in that territory that photographs were taken of the Rice Lake and Red Lake districts. Maps of these areas were issued in time to be placed in the hands of prospectors during the "rush" in the spring of 1926. The latest map of this type to be issued is known as the Carroll Lake sheet, which covers the area lying immediately to the north of, and touching, the Rice Lake and Red Lake fields. This map was of great service to the prospector, as it showed more than 3,000 lakes, thousands of islands, numerous connecting waterways, and even reefs not shown on previous maps. Toward the close of 1926 photographs were taken of the area lying to the east and southeast of the Red Lake region, including the mineralized areas of Woman Lake, Birch Lake, and Savant Lake. Four maps were prepared of this work. At the close of last season almost 6,000 claims had been recorded in these districts. This fact clearly shows the importance of the service rendered by the aërial maps.

Moore Mine Hopes to Pick Up Argonaut Vein

On the 1,800 level of the Moore mine, near Jackson, Calif., a crosscut is being extended west to intersect the Argonaut vein believed to extend through the property of the company. The crosscut has reached a length of 1,120 ft., and it is estimated that about 475 ft. remain to be driven. The working shaft is now at 2,080 ft. No milling is being done. An additional assessment of 1c. per share has been levied to provide funds for continuing exploration.

Recent Development Encouraging in Michigan Copper District

Lake Linden and Tamarack Plants Make Good Recovery From Old Waste Sands

Development work in the conglomerate bed of Calumet & Hecla Consolidated, in the Michigan copper district, offers much encouragement for the future of operations on this formation. Valuable stoping ground is being opened below the 80th-level haulage tunnel in No. 7 shaft in the Hecla branch and to the north in the five forties which are mined through a blind slope shaft, sunk from the 57th level of the Red Jacket shaft of the Calumet branch. A raise from the 63d level of the slope shaft into Tamarack Junior ground is also advancing through good stoping rock. The work now in progress is opening large reserves and indicates long life on the conglomerate.

Although No. 7 shaft has reached the 91st level, no stoping is being done below the 80th. A vigorous program of opening work is under way, however. Drifts have been pushed on the 81st, 83d, 84th, and 85th levels, and plats have been cut at all levels below the 86th, preparatory to drifting. The greater part of this ground will be available for stoping, which will start with the completion of the electric hoist at the 80th level. The conglomerate will also be extensively opened below the haulageway in No. 4 Calumet shaft, which will be served by an electric hoist at the 78th level.

The five forties lying between the Tamarack and Tamarack Junior tracts, which carry the underlay of the conglomerate vein and about half of the

new ground opened from the 64th to the 67th level of the slope shaft, are being held in reserve for stoping. The raise into Tamarack Junior workings will supply not only ventilation, but also access to additional copper areas recently developed.

Enrichment in No. 6 shaft is an important factor in the operation of the Mohawk mine. The opening of high-grade rock in the lower levels was largely responsible last year for a yield of 25.43 lb. of refined copper per ton of rock treated, compared with 23.98 lb. in 1925, and a production of 18,340,712 lb. in 1926, compared with 16,394,006 lb. the preceding year. No. 6 shaft contributes almost half of the rock output. It is the shallowest of the three working units, being bottomed at 2,504 ft. It has a long life, for it can be sunk a maximum of 4,000 ft. The shaft commands about three-fourths of a mile on the strike of the Kearsarge bed under about 160 acres, or approximately as much ground as the entire Wolverine mine had on this mineral formation.

Mineralization also continues good in No. 4 shaft, which is supplying about 30 per cent of the rock. No. 1 shaft always has been comparatively lean, and close selection is necessary. The remodeling of the concentration department in the stamp mill will be instrumental in cutting down current tailing losses.

There has been ample evidence of improvement in milling practice in the district by the recovery of 8,290,076 lb. of copper by table treatment of waste conglomerate sands at the Lake Linden and Tamarack reclamation plants of Calumet & Hecla Consolidated last year. The coarse sands were subjected to table treatment, and the fines to leaching and flotation. About 18,212,000 lb. was recovered through leaching, and 4,486,000 lb. through flotation. Results at the plants vary as new areas of sands are dredged. When deposits dumped into Torch Lake during the earlier years of Calumet & Hecla are encountered the yield is higher on account of the cruder methods of extraction employed in the earlier days. Sands deposited in later years contain considerably less copper, the losses decreasing as methods improved.

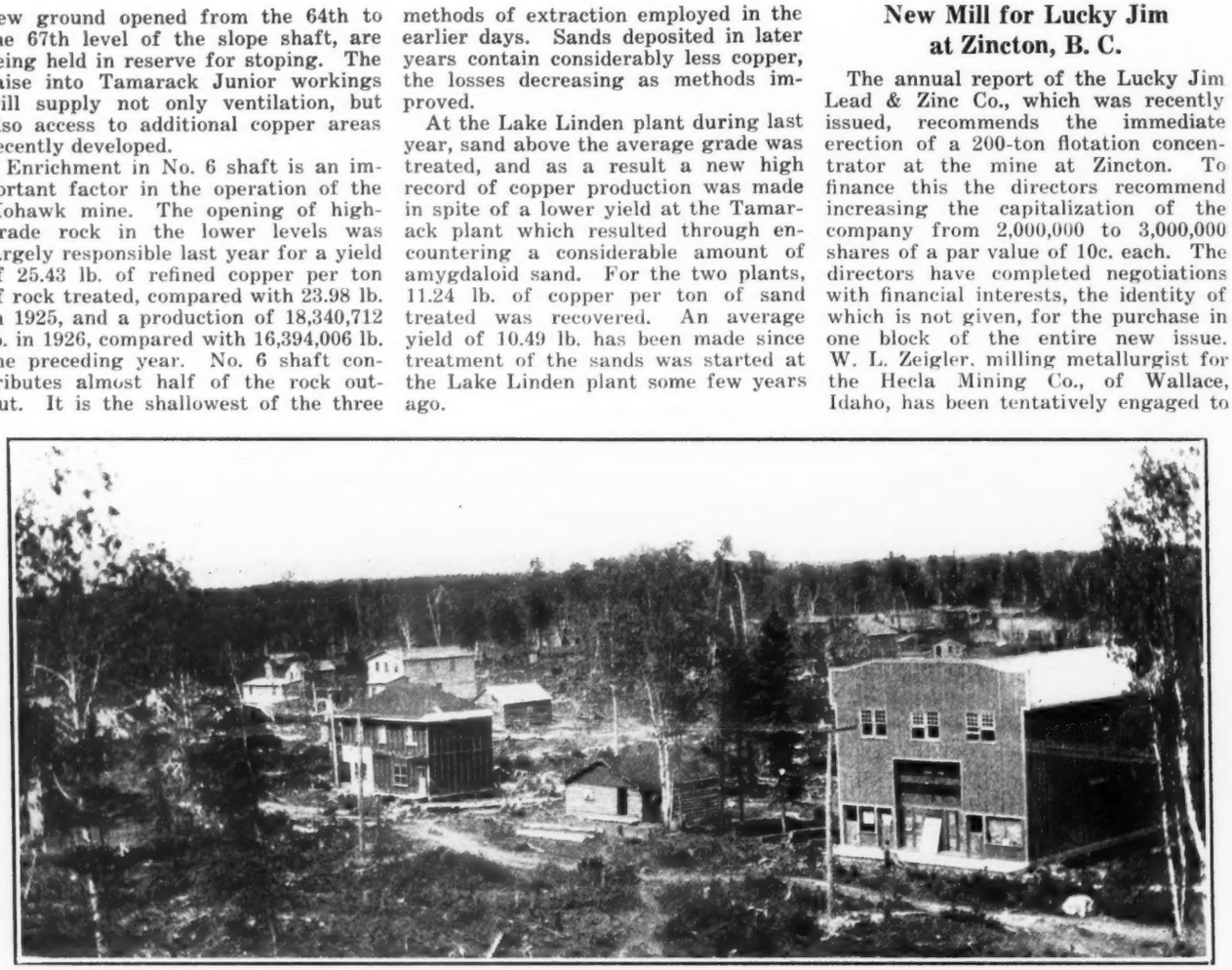
At the Lake Linden plant during last year, sand above the average grade was treated, and as a result a new high record of copper production was made in spite of a lower yield at the Tamarack plant which resulted through encountering a considerable amount of amygdaloid sand. For the two plants, 11.24 lb. of copper per ton of sand treated was recovered. An average yield of 10.49 lb. has been made since treatment of the sands was started at the Lake Linden plant some few years ago.

New Mill for Lucky Jim at Zincton, B. C.

The annual report of the Lucky Jim Lead & Zinc Co., which was recently issued, recommends the immediate erection of a 200-ton flotation concentrator at the mine at Zincton. To finance this the directors recommend increasing the capitalization of the company from 2,000,000 to 3,000,000 shares of a par value of 10c. each. The directors have completed negotiations with financial interests, the identity of which is not given, for the purchase in one block of the entire new issue. W. L. Zeigler, milling metallurgist for the Hecla Mining Co., of Wallace, Idaho, has been tentatively engaged to superintend the construction of the mill.

During 1926 the company shipped 20,478 tons of ore, averaging 4.34 oz. of silver per ton, 3.59 per cent of lead, and 12.71 per cent of zinc, to the custom concentrator at Trail. The net value of the ore at the smelter averaged $5.35 per ton, from which $3 for treatment and $1.60 for freight has to be deducted, leaving a profit to the company of only 75c. The ratio of concentration was 3.57 to 1. The average recovery was 69 per cent of the lead and 86.5 per cent of the zinc.

The directors estimate that on the basis of 200 tons per day, which the mine is easily capable of producing, a saving of $2.90 per ton would be made by milling the ore at the mine. Moreover, the mine produces considerable quantities of lower grades of ore that, though it cannot profitably be shipped to Trail, could be treated at a profit by a concentrator at the mine.



Rouyn Townsite, Quebec

Rouyn Townsite Purchased

J. J. Carrick, of Toronto, Ontario, recently secured control of the townsite of Rouyn, Quebec, for approximately $500,000. The transaction, according to reliable report, is the largest individual purchase of real estate ever recorded in the North country.

Exceptional activity is being shown in Rouyn. Although the town is in the grip of winter, building is proceeding in anticipation of an influx after the break-up. The population is now 3,000.

Britannia M. & S. Selling Iron Sulphides

An interesting development has been worked out by the Britannia Mining & Smelting Co., a subsidiary of the Howe Sound company. The Britannia ore contains considerable pyrite and pyrrhotite, which until lately has been allowed to flow away with the tailing. Recently an addition was made to the mill to allow a separation, or partial separation, to be made of the iron sulphides from the earthy minerals in the tailing. The company now is selling about 4,000 tons of iron sulphides per month to pulp and paper manufactures, who are using it in place of native sulphur, and who are said to be making a considerable saving thereby.

Texas Gulf Seeks New Deposit

The Texas Gulf Sulphur Co. is negotiating a lease of the Clemens sulphur mound, in Brazoria County, Tex., where superficial development work has resulted in attractive showings. Most of this acreage is owned by Roxana Petroleum, a Dutch-Shell subsidiary; the remainder is owned by various interests.

Much Development Work at Arizona Properties

Mohave County, Oatman, and Kingston District Operations Increase—High Values at Arnold Mine

Production of complex ores and gold in Mohave County, Ariz., is continuing to increase, and the prosperity of the producing properties is stimulating development activity. The Chloride Mining Co.'s new mill has just been placed in operation on a twelve-hour basis, and is handling ninety tons per day. It is expected that the plant will soon be running the full twenty-four hours, and that the daily tonnage treated will be increased to 200. By means of selective flotation a good recovery of both the lead and zinc values is made. Besides treating the Chloride Mining Co.'s ore, the plant is receiving consignments from several other properties in the chloride district.

At Oatman the Tom Reed property, under the management of Jack Shank, is producing and milling seventy-five tons of gold ore per day. Most of this is coming from the Aztec, where the Tom Reed is mining in the territory formerly leased to Shank and Schmidt. A contract has been given to Ross Bradley to sink a shaft on the Baltic property to a depth of 700 ft. The Baltic was recently acquired by the Western Apex Co.

In the Katherine district the Black Dyke group of claims has been acquired by E. C. Jacobs, a Los Angeles mining engineer, and his associates, who are E. C. Chamberlain and Walter Laidlaw, of Edmonton, Canada. A 300-ft. shaft is to be sunk as a preliminary operation to drifting exploration. The property is in the foothills above the town of Katherine.

The pilot mill at the Comstock Silver property, in the Kingman district, is extracting two truck loads of lead and zinc concentrates from seventy tons of ore daily. A company known as the Oro-Golconda Mining Co. has been organized to take over the property of the Oro-Plata, Middle-Golconda, and Golconda mining companies. The last named was a big producer of zinc during the war. The price paid for the claim by the new company is said to be $1,000,000. The combined properties are to be explored by means of a new tunnel, which will be driven at a level lower than any previous workings. Not to be outdone in the matter of new bonanzas, the district points to the Arnold mine as a rival for Weepah and Tornado. Samples across a 20-in. vein at the Arnold are reported to assay as high as 27.28 oz. gold and 372.14 oz. silver per ton.

According to a recent report, the Great Bend Gold Mining Co., a Nevada corporation headed by J. K. Turner, has acquired the Goldroad, Redtop, Winslow, and White Hills groups of claims at Goldroad, Ariz. The area covered by the combined groups amounts to 1,300 acres. Goldroad's mine and mill have been held under lease and bond to Jack Shank from the U. S. S. R. & M. Co. The mill was overhauled last year, and has been treating about a hundred tons of ore per day from the mine. Mr. Shank has been retained by the new company as manager. On the White Hills group, the sinking of a 1,000-ft. shaft has been started, and this work is to be continued.

At Oatman the Oatman Eastern Gold Mines Co., through its president, James J. Moss, has raised capital for a campaign of development. The 500-ft. Telluride shaft, which lies on a claim adjoining Oatman Eastern ground, has been leased for a long term of years. From it a number of exploration drifts will be driven.

McCrea Intimates Custom Smelter for Sudbury District

Speaking in the Ontario Legislature a few days ago, Charles McCrea, Provincial Minister of Mines, referred to the lead, zinc and copper deposits that have been found in the Sudbury districts of northern Ontario. "The work which has been going on there for the past year and a half by way of exploration and diamond drilling," he said, "would indicate that in the Sudbury basin there is a substantial body of ore that will play a very important part in the industrial expansion of mining in northern Ontario.

"The government," the minister said, "is keeping in close touch with this exploration and development. The work is progressing on the ground, and we propose as that work develops that there will be established in association with it a custom smelter and refinery for the province, where the small miner can mine his ore and ship it in small or large quantities to a custom smelter, obtain payment for his ore when delivered, and the money go back to keep opening up his mining wealth."

C.&H.'s 80th Level Almost Ready

The 80th or main haulage level in the conglomerate department of the Calumet & Hecla Consolidated, Michigan copper district, will go into commission early this year. Installation of two electric hoists, at the 80th level of No. 7 Hecla shaft and at the 78th level of No. 4 Calumet, is well under way. Equipment for the haulageway, including two 10-ton electric locomotives and large steel tram cars, has been on the ground for some time. Automatic dumping of the cars at the Red Jacket shaft will facilitate hoisting.

The company will push its exploratory crosscut with three instead of two shifts. The crosscut, which starts from the 417-ft. level of No. 2 shaft just below the Osceola lode, has been driven about 1,000 ft. It is understood that nothing of importance has been so far disclosed. The crosscut, which will be pushed at least 2,200 ft. through the Houghton conglomerate and possibly farther, will cut a large number of veins in a territory which is considered of unusual promise.

Red Lake Centre Acquires More Properties

The Red Lake Centre Mines, Ltd., has purchased all the holdings in the Red Lake district of northern Ontario formerly owned by the Victoria Syndicate and is now in possession of twenty-three properties.

Production of Bauxite in U. S. Increases in 1926

Production of bauxite in the United States in 1926 was 392,250 long tons, valued at $2,415,200, an increase of 24 per cent in quantity and 21 per cent in value compared with the domestic production of 316,540 long tons, valued at $1,988,250 in 1925, according to the U. S. Bureau of Mines.

Production of bauxite in the Arkansas field was 371,570 long tons in 1926, an increase of 25 per cent compared with 1925. The eastern field, including Georgia and Tennessee, produced 20,680 tons, an increase of 2 per cent compared with 1926. No bauxite was produced in Alabama or Mississippi in 1926.

Imports of bauxite in 1926 amounted to 281,644 long tons, valued at $1,187,497 (an average of $4.22 a ton), a decrease of 20 per cent in quantity compared with imports in 1925. Imports were chiefly from the Guianas and Dalmatia, though some French bauxite was imported. Imported bauxite is used chiefly by the chemical and cement industries on the Eastern seaboard. Quotations on foreign bauxite were: Dalmatia, low silica, $5 to $6.50; Istrian, $5.50 to $7; and French red, $6 to $7.50, c.i.f., a metric ton.

Exports of bauxite, including bauxite concentrates (alumina), in 1926 totaled 87,770 tons, valued at $4,741,260 ($54.02 a ton), an increase of 12 per cent in quantity compared with exports in 1925. Exports were largely to Canadian and Norwegian aluminum plants.

The value of new aluminum in the United States during 1926 was $36,583,000, an increase of less than half of 1 per cent compared with 1925. Aluminum bronze powder, as a paint pigment, and aluminum foil were used in increasing amounts. Manufacture of aluminum furniture was further developed during 1926. The electrical industry continued to consume large quantities of the metal, but the automobile industry remained the largest consuming industry.

Imports ("general") of aluminum metal, scrap and alloy in 1926 increased over 72 per cent compared with 1925, reaching a total of 74,878,767 lbs., valued at $17,107,690, in 1926. Imports of plates, sheets and bars increased 24 per cent, amounting to 127,202 lbs., valued at $36,776, in 1926. Hollow ware imports in 1926 totaled 215,265 lbs., valued at $99,458. Total imports of aluminum in 1925 were valued at $10,536,639 and in 1926 at $17,502,435. Exports of aluminum ingots, scrap and alloys in 1925 were 8,130,222 lb., valued at $1,835,213, but in 1926 were only 586,749 lb., valued at $137,980. Exports of plates, sheets, bars and other forms in 1926 were over 56 per cent greater than the quantity sent abroad in 1925, totaling 7,047,422 lb., valued at $1,997,107, but exports of tubes, moldings and castings decreased 41 per cent. Table and other manufactured ware exported declined 16 per cent in value, but other aluminum manufactures increased 29 per cent in value. The total exports of aluminum in 1925 were valued at $6,057,071 and in 1926 at $4,452,303, representing a decrease in value of $1,604,768 in 1926.

Recently completed cottages for officials of the Fairbanks Exploration Co., Fairbanks, Alaska

Office building of Fairbanks Exploration Co. Concrete block construction

New Operations at Argonaut

Stimulated by the good results at the Kirkland Lake Mines, where better showings occurred at depth, the management of Argonaut Consolidated Mines, Ltd., decided a year ago on a large program of development for the Argonaut mine, at Argonaut, Ontario. Two new levels were opened in 1926, one at 875 ft. and the other at 1,000 ft. Good ore was encountered, and diamond drilling gave the assurance of still better mineralization further down, so in December last 1,250 ft. was set as the objective. This level was reached on April 5.

A station is now being cut out on the 1,250 ft. level. In a few days all machinery will be in place, and drifting will start on both the 1,125 ft. and 1,250 ft. levels. Four veins 1,014, 1,018, 1,022, and 1,037, well defined and capable of good production, have been opened on the 1,000 ft. level. These veins run from 135 ft. to 150 ft. in length. Three veins should be reached on the lower level within 100 ft. to 150 ft. from the shaft. Everything points to larger production at Argonaut in the near future.

Will Employ 1,000 at Fairbanks This Summer

It is reported that the first two large dredging plants for the Fairbanks Exploration Co.'s operations at Fairbanks, Alaska, are to be delivered by September. Although active dredging operations are not scheduled to begin prior to the spring of 1928, it is expected that preliminary work will give employment this summer to about 1,000 men. W. H. McFarland, formerly on the staff of Yukon Gold, is in charge of the company's development operations at Fairbanks.

Central Manitoba's Mill Assured

The Central Manitoba Mines has succeeded in obtaining delivery on the property of all the important equipment for its mill before the break-up of the winter roads, so that construction of the mill during the coming season is assured. Most of the work done recently has been the blocking out of ore for milling. Progress is being made with the company's transmission line from Great Falls.

Porcupine Stemwinder Shut Down

Porcupine Goldfields Development & Finance Co. has shut down work at the Stemwinder mine, at Kimberley. It is rumored that the company will allow its option on the property to drop. The ore at the Stemwinder mine frequently has been described as being similar to that at the Sullivan mine, which it adjoins. Both are intimate mixtures of pyrrhotite, pyrite, galena, and zinc blende; the earthy mineral content of the Sullivan ore rarely exceeds 6 per cent, whereas that of the Stemwinder runs considerably higher. For successful treatment most of the Stemwinder ore has to be crushed to pass 300 mesh, and during the treatment the silica appears to become colloidal and causes trouble at the filters. The Porcupine company claims to have developed 100,000 tons of ore above the 200-ft. level at the Stemwinder, about one-fifth of which has been shipped and treated. It is understood that, for the reason mentioned, the shipping of the ore has not been profitable.

The Porcupine company has dropped its option on the Lynn Creek zinc mine, near North Vancouver. It is still operating several properties in the Kootenays and is doing considerable exploration to locate the southern extension of the Red Top ore zone, near Topley, on the Canadian National Railway.

Scene on line of 74-mile ditch of Fairbanks Exploration Co.

Note: Driving piling to carry an inverted siphon across Cleary Creek. A tailing dump and water wheel of earlies days may be seen at left near triangulation station.

Important Discovery at Dufresnoy, Quebec

Diamond drilling has been started on the property of Copper Hill Mines at Dufresnoy, Quebec. This property consists of about 400 acres, in the central part of Dufresnoy Township, adjoining the properties of the Clericy Mines and the Harvie Archean Mines. Present indications are that it is one of the most important of the many recent discoveries made in northwestern Quebec.

Considerable surface work has already been done, disclosing excellent showings. Several channel assays over a width of 17 ft. have averaged more than $11 per ton in copper, silver, and gold.

The limits of the mineralized area have not yet been determined, but, according to the engineer's report, the present showings are so located that a total length of over 3,000 ft. could be developed before running beyond the property lines.

Joplin-Miami District to Be Well Represented at St. Louis

Fourteen Fatal Accidents in Three Months—Two Due to Tailing Slides at Re-treatment Mills

It is expected that about sixty mining men from the Joplin-Miami district will attend the annual meeting of the American Zinc Institute, to be held in St. Louis on April 18 and 19. Important matters coming before the Institute this year include a report from the "get-together" committee of operators and smeltermen; the increased production of Western complex ores; and the smeltermen's offer to issue monthly statistics similar, in their branch of the industry, to the monthly figures prepared by the ore producrs.

During the first three months of 1927 fourteen fatal accidents occurred in the Joplin-Miami field. Only two were at properties where full-time safety engineers are employed. Two of the accidents were the result of tailing slides at plants where tailings were being re-treated. The Brewster mine of the Federal M. & S. Co. continues to hold the "1927 Plaque," the reward for having a record of the greatest number of consecutive man-shifts without a lost-time accident. The last report was that the Brewster had gone 7,815 consecutive shifts without a lost-time accident.

A new type crusher to be used in the district—a Symons cone crusher—will be installed at the Hutcheon mill of the Inter-State Zinc & Lead Co. These crushers have been successfully used for several years in the lead field of southeastern Missouri.

The Tri-State Mining Co., Inc., has been carrying on a drilling campaign on the Roanoke lease, which is just north of the Commerce Mining & Royalty Co.'s Scammon Hill mine. Results have been sufficiently encouraging to warrant repair work being done on the near-by S. S. & G. mill, over which the mine dirt will be milled. The dirt from the lease will be trammed on the surface to the S. S. & G. mill. The Tri-State company now has 200 acres of leases in this immediate vicinity.

A new mine just opened up in the Joplin-Miami district has been named the Weepah. It is located in Oklahoma, just south of Baxter Springs, Kan., and is owned by James Warren, Thomas Bailey, and Thomas Sims.

F. W. Evans, of Picher, Okla., has taken over the Barnsdall No. 5 mine, west of Baxter Springs, Kan. A hopper and derrick have been erected at the new shaft on the northwestern part of the lease. The tract consists of 100 acres, and has a good concentrator.

The new re-treatment mill of the Commerce Mining & Royalty Co., located on the Blue Goose tract, was recently put into operation. The mill is an innovation in the district in that the entire mill production is made in the flotation department.

The Consolidated Lead & Zinc Co. has taken an option on the Peck and Dorris leases, located just north of Quapaw, Okla. The leases will be thoroughly drilled.

The American Zinc, Lead & Smelting Co. is sinking four shafts to the 280 level of the High Five mine, at Waco.

News From Washington

By PAUL WOOTON
Special Correspondent

Requests Made for Federal Distribution of Information Essential to Mining Industry

WITHIN three months requests from at least four sources have reached Washington for federal aid in gathering, at home and abroad, information essential to the mineral industries of the United States and to the consumers of those commodities which the aforesaid industries produce. The requests embrace the establishment of a permanent clearing house of information; the dissemination of information bearing on the remaining resources of minerals in the United States and in other countries; and current data as to production, preparation for market, transportation, marketing, and use of mineral commodities. Secretary Hoover recognizes that there is a great need for such a service, and states that he will do all in his power to get it started. He points out, however, that the Bureau of Mines, which would have to undertake the main responsibilities in connection with such a program, is having great difficulty in stretching its appropriation so as to cover the essential work already assigned to it. He does believe, however, that a start can be made, in the hope that Congress may be induced to provide funds for that specific purpose.

Important co-operation can be furnished by the Bureau of Foreign and Domestic Commerce, the Geological Survey, the Foreign Service and the Economic Adviser of the State Department, the Bureau of the Census, the Customs Service, the Tariff Commission, and other federal agencies. An important part of the program would be to keep the mineral industry of the United States informed as to restrictive, or discriminatory, laws or practices in foreign countries, and as to mineral concessions that are granted. That close contact may be maintained with the mineral industries, it is probable that an advisory committee to the Secretary of Commerce will be set up.

An application for the reduction in the duty on manganese ore has been filed with the Tariff Commission. It is contended that the consumers of manganese in the United States are being required to pay out $3,000,000 annually to support $300,000 worth of domestic production. The suggestion also has been made that the present duty be retained on chemical manganese, but that relief be given the consumers of metallurgical ore. That plan, however, would have to await revision of the tariff.

7,000 Ft. Crosscut Tunnel in Coeur d'Alene District Completed

The Atlas Mining Co. recently completed driving a crosscut tunnel over 7,000 ft. long near Mullan, in the Coeur d'Alene district, Idaho. This crosscut is on the side of a wide canyon across from the Gold Hunter mine. The purpose of the crosscut was to reach three known veins at depth.

Electrical equipment amounting to more than $100,000 in value has recently been ordered by the Sullivan Mining Co. for use in the electrolytic zinc plant now under construction at Kellogg. Construction of the main building, which is 305 ft. long and 216 ft. wide, is under way. The estimated cost of the zinc plant is $1,250,000. Its output will be 50 tons of metallic zinc per day.

Plans of the company include construction of two more units of like capacity upon the completion of this plant, the purpose being to provide eventually a local market for the zinc ores of the Coeur d'Alene district. The zinc of the district is in combination with lead. Plans also contemplate construction of a custom mill for the treatment of this class of ore, the zinc concentrate going to the Sullivan zinc plant, and the lead to the Bunker Hill smelter, which is also at Kellogg.

The construction of the zinc plant has already given an impetus to the development of zinc mines in the Coeur d'Alenes.

U. S. Steel Acquires Monarch Mine

The United States Steel Corporation, through subsidiary connections, has concluded negotiations for taking over and operating the Madonna mine, at Monarch, Colo. It is understood that the mine is merely the first step of the Steel company's plan to obtain an independent supply of zinc for the manufacturing needs of its subsidiaries.

The Universal Exploration Co. has been investigating zinc and lead properties for the United States Steel Corporation in Canada, Mexico, Alaska, Arizona, and, more recently, in Colorado. The company has reported favorably on several other Colorado properties, and it is expected that these will soon be acquired by the corporation.

Contract Let for New Mill at Steins, N. M.

A contract has been awarded for the design and erection of a 100-ton concentrating mill by H. E. McGhee & Co., who are developing a silver-lead property 5 miles from Steins, N. M. The mill will combine gravity concentration and flotation. A 3-mile pipe line and Diesel driven pump will supply water. Mine and mill power will be supplied by a 240-hp. Diesel unit. A Los Angeles, Calif., engineering and construction company is in charge of the work. It is planned to complete the entire contract by June 15.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Ontario Operations Expanding—Improved Aërial Service for Haileybury-Rouyn Section

The Castle-Trethewey mines, of Gowganda, has encountered high-grade ore on its No. 10 vein at the 700 level. This discovery is considered to be particularly interesting as the 700 level is below the middle of the diabase sill.

The theory held with regard to the silver deposits of northern Ontario is that the veins extend only a few hundred feet from both the upper and lower contacts of the sill, which is approximately 1,000 ft. thick, and that there is no connection between veins on the upper and lower contact. If the Castle has ore below the middle of the sill, there would appear to be a reasonable possibility of its extending through to the bottom.

All the silver in the Gowganda district, to date, has come from the upper contact, although in Cobalt approximately 80 per cent came from the lower contact. Noranda has been developing the Plata mines, in the Gowganda district, but it is understood that the option will be dropped, because, although a number of strong veins were encountered and explored to some extent, no silver has been found.

At the Frontier mine of the Mining Corporation, in South Lorrain, some remarkable widths of high-grade ore have recently been encountered. This ore was found on the Watson vein above the 225 level, and in places shows 4 ft. of ore running several thousand ounces to the ton. At the adjoining Keeley property, the 16-28 vein system has been developed to the 12th level or 895 ft. below the surface. Some rich ore has recently been encountered which gives a total depth of ore in this particular system of 400 ft.

On the Canadian Lorrain property, which is controlled by the Keeley interests, it has been decided to undertake an extensive campaign of exploration and development. Since the mill started last November, stoping results have not been as good as indicated, and this, with the drop in the price of silver, has resulted in a loss in operating the property. Officials of the La Rose mines, of Cobalt, announce that operations on both the Cobalt property and the Rouyn claims will be undertaken soon.

At the annual meeting of the Dome Mines, of Porcupine, held in Toronto on April 5, shareholders approved the recommendation of the directors that the dividends should be cut from $2 to $1 a share per year. R. F. Segsworth of Toronto, was elected to the directorate replacing Wallace Nesbitt.

The general manager in reviewing the situation at the mine stated that nothing striking had occurred since the former meeting. Some new orebodies had been encountered, but more ore was milled than was developed, and, as a consequence, there was a decrease in the amount of broken ore. To date, there is no reason to change the estimate made in the annual report that the mine is good for at least two years at the present rate of production.

On the new 17th and 18th levels considerable difficulty has been experienced in finding the intersections indicated by the diamond drills. The ore found to date consists of small scattered orebodies. The most important announcement made was the intention to sink to a depth of 3,000 ft., a course which has been advocated for some time by a number of different engineers. The winze which was started near the Dome extension boundary, and sunk to the 18th level, will be continued another 800 or 1,000 ft. in the hope that at this depth geological conditions may have changed, and that orebodies may be found similar to those in the Hollinger-McIntyre section of the camp. Such an undertaking represents a long chance, but appears to be justified, on account of the past history and earnings of the mine.

At the recent annual meeting of the Coniaurum Mines, of Porcupine, shareholders approved the proposal of the directors to increase the company's capital from $5,000,000 to $6,000,000 by the creation of 200,000 new shares of $5 par value, and by providing for the issue and allotment of such new shares as the directors may deem expedient. The property is developed to the 1,250 level, and it is expected that the shaft will be continued another 500 ft. and the vein systems opened up at that level before a definite decision is arrived at regarding the building of a mill. The company has over $200,000 on hand at the present time. To complete the development program, and build a 500-ton mill, would necessitate raising approximately $600,000 additional.

The Patricia Airways Co., which operates a plane service from Haileybury to Rouyn, and from Sioux Lookout to Red Lake, is providing improved service for the Haileybury-Rouyn section. Two new passenger and freight planes equipped with closed cabins will be put on this route. Flying time is to be cut down to forty minutes. The fare is $35 one way, and $60 return.

The Noranda Mines has taken an option on the Hill-Drew group of properties in the Kamiscotia area, at a total purchase price of $120 000. Exploration work will be started as soon as possible.

F. M. Connell and J. H. C. Waite have taken an option on the Steep group to the south of the ground optioned by Noranda. A gang of men is now on the ground sampling the surface.

The Hollinger has a complete mining plant and all necessary supplies on the ground and has obtained permission from the Ontario Government to run a power-transmission line to its properties. A shaft has already been started by hand.

Part of the mill equipment for the Gold Hill property near Kirkland Lake has arrived on the ground, and preparations for the erection of the mill are proceeding. The excavations are under way and the pouring of concrete should be started soon. It is stated that the mill will have a capacity of 175 tons a day. Officials of the property speak encouragingly of its possibilities.

London Letter

By W. A. Doman

Special Correspondent

New Process Recovers Tin From Slime Tailings—Good Gold Near Bulawayo

London, March 29—Interest in mining at the moment is mainly in tin, not only from the standpoint of the formation of new companies and the expansion of old, but from the fact that a new tin-recovery process is reported. Although the inventors of the process are not named, they are believed to be the Minerals Separation people. Experimental work has been carried on for some months at one of the Cornish mines; it is said that tin has been obtained from "slime" hitherto regarded as waste and that this is the first tin to be so produced. According to the *Daily Mail* correspondent, it is claimed for the new process that it will make possible the recovery of 85 to 90 per cent of the mineral content of the tin slime. It is stated that the process is well beyond the laboratory stage and will permit the principal Cornish mines to market, in addition to their tin oxide, a low-grade material which is at present unsalable. Technical details of the process are not yet available for publication.

The Dolcoath company has struck a lode at the 2,000 level in the Roskear property, near Camborne. Much is expected of this new area, for the development of which the company received government assistance under the Trade Facilities Act.

As regards Nigeria, an informative interim report has been issued by the Nigerian Base Metals Corporation. The document is accompanied by a capital map of the Nigerian tin fields, which is useful as showing where the different groups of mining companies operate. The map is on a scale of 5 miles to the inch. The directors of the corporation are, as I have previously mentioned, going to harness the Kurra Falls and to erect a hydro-electric generating station. The estimated cost of the installation necessary to generate a minimum of 4,000 hp. is £150,000.

A discussion has taken place as to whether the improved production of tin —in Cornwall by the new process and in Nigeria by the hydro-electric process —may not increase the supply of the metal beyond requirements. It is pointed out, however, that new companies cannot extract tin immediately, that handsome profits can be made with the metal at a lower price than it is today, and that an augmented supply would probably mean extended uses in industry.

There is talk of the discovery of a promising gold property in Southern Rhodesia about 60 miles from Bulawayo. The owners have worked it with a small plant for the last twelve months, and, according to information received, the average recovery has been well over an ounce to the ton.

Although some time ago Lena Goldfields shares were a favored speculation they have recently fallen out of favor owing to the industrial position.

Mexico City Letter

By W. L. Vail

Special Correspondent

January Copper-Lead Exports to U. S.—Minister Morones Expresses Views

Mexico City, April 4—According to a statement given out by the mining department of the federal government, 9,478 ingots of copper were shipped to New York City from Mexican mines during January of this year; shipments for the preceding month and a year ago were 6,781 and 5,769 ingots respectively. On account of overproduction, there were still on hand in the Mexican markets in January, 1927, 272,342 tons of copper matte, an excess of 12,156 tons over one year ago. The same statement says that $113,756 bars of lead were shipped to the Port of New York in January of this year; shipments for the preceding month and a year ago were 191,410 and 31,337 bars respectively. The total exportation of lead last year amounted to 235,804,226 lb.; this total exceeds that for 1925 by 28,853,141 lb.

Minister Morones of the Department of Industry takes exception, in a published letter, to statements of mine operators from Sinaloa to the effect that the present mining laws are injurious, and, in many instances, have completely paralyzed mining operations on the West Coast. The minister cites the fact that in 1910 the values of the principal metals from Mexican mines reached the sum of 210,723,411 pesos; in 1926 values totaled 319,279,828 pesos. He also cites the alleged prosperity of two large camps on the Pacific coast—the Candelaria, at San Dimas, Durango, and Nuestra Señora, in Sinaloa—as arguments against the mine operators' conclusions. The operators cite the closing of numerous properties to sustain their contentions. The minister denies the allegation that under the new laws taxation has risen from 40 to 90 per cent of the cost of operation, and insists that much of the stagnation is due to conditions which prevail throughout the world, and which are not peculiar to Mexico or the result of legislation of the present administration.

"It is not to the interest of the government," says the minister, "to encourage activity in new denouncements so much as to stimulate work on those properties already in operation, and those which, through one cause or another, have lain idle for many years. The spirit of the law is to discourage denouncements for speculative purposes and to encourage the prospector who actually works his claims." He states that statistics show that in 1925 there were 89,750 mine workers; he assumes that this figure has increased considerably.

Properties of the Hileta Gold & Silver Mining Co., State of Durango, have been transferred to the San Mateo Mining Co., at Velardeña, Durango, with headquarters in San Antonio, Tex. This same company is now working the Carmen, La Espundia, and San Mateo properties, in the same district.

The Dinamita Mining Co., Santa Eulralia, Chihuahua; the Corona, at Yago, Nayarit; and El Tajo, at Rosario, Sinaloa, have suspended operations. The last-named property is one of the best-known and largest silver producers in Mexico. It is controlled by the Bradbury interests, of Los Angeles, and has returned millions of dollars in dividends.

The Mexican Industrial Co. expects to resume work on its properties at Concepcion del Oro, Zacatecas, some time in June; work there has been suspended since the early part of November, 1926.

Mining agents throughout the republic have been instructed to accept photostatic copies of documents, when desired by the petitioners, in place of typewritten copies.

Organization of the Aurora Mining Co. with American capital has been completed, and the new concern is taking over the Aurora de Xichu mines from the Peñoles company. The latter company had been working the properties on a purchase option.

The Minerva Mining Co., Asientos, Aguascalientes, is installing a 750-kw. steam turbine to supply additional power. The plant is now operated with a 625-hp. Diesel engine.

Silver-Lead-Zinc Field at Ranger Lake Active

Good progress is being made with the two-compartment shaft now being sunk on the property of the Canadian Exploration Survey in the new silver-lead-zinc field at Ranger Lake, just north of Sault Ste. Marie, Ontario. The shaft is 7 ft. by 14 ft., allowing two drill crews to work on both day and night shifts. At the beginning of April a depth of 17 ft. had been reached.

Thirty-five men are employed at the property in addition to those engaged in the transport of supplies from the railway. Forty claims in the area have been placed under option by the Consolidated Smelters, after investigation by P. E. Osler, engineer for the company. Canadian Exploration Survey holds two important groups on the strike. Several other negotiations are reported to be pending for properties in the area.

Diamond, Galena and Southern Cross, at Butte, to Operate

The Diamond mine of the Anaconda Copper Mining Co. of Butte, Mont., which closed down on March 12 following an accident to the cable reel, has resumed operations with a crew of 650 men, according to an announcement made by C. L. Berrien, general superintendent of mines.

The Galena mine and mill, near Norris, Mont., is being put in condition for resumption of operations by Hugh Martin and associates, of Butte.

For the last few months Lucian Eaves and associates, of Butte, have been reconstructing the cyanide plant at the Southern Cross mine, at Georgetown, Mont.

Johannesburg Letter

By John Watson

Special Correspondent

Diamond Production Increases—Tambo Tin Shares Offered—Consol. Main Reefs Up

Johannesburg, March 8—The following results of crushings, for the month of February, from sixteen leading Rand gold mines, have recently been published. The mines are arranged in the order of profits earned.

	Tons Crushed	Value or Revenue £	Costs per Ton s.	d.	Estimated Profit £
Government Areas	184,000	353,727	16	4.7	205,130
New Modder	120,000	274,940	18	8.9	162,471
Crown Mines	189,000	259,495	20	3.6	67,636
Modder Deep	41,400	93,498	15	6.0	61,365
Springs	64,800	121,572	19	8.5	57,724
Brakpan	78,200	128,097	19	5.3	52,067
New State Area	66,000	121,179	21	8.5	50,205
Van Ryn Deep	58,200	99,419	17	11.9	48,101
Modder B	63,000	104,239	18	5.4	46,130
Geduld	77,500	109,372	16	7.0	45,175
Sub Nigel	17,500	.....	39	8.2	30,645
West Springs	46,200	72,773	19	2.5	28,395
Randfontein	190,000	197,865	18	2.5	27,670
Langlaagte Estate	73,500	94,509	20	6.5	20,012
City Deep	82,000	116,808	24	0.9	18,113
Robinson Deep	63,200	.....	20	3.4	15,832

The total mineral output of the Union for January reached a value of £5,170,813. This amount represents an increase of £125,705 over the previous month, and is accounted for by increased diamond production. Mineral production statistics for these two months follow:

	Jan., 1927	Dec., 1926
Gold	£3,578,872	£3,537,501
Silver	9,865	9,018
Osmiridium	7,163	4,062
Platinum	16,723	10,958
Diamonds	1,112,632	980,196
Coal	294,883	377,569
Copper	85,173	66,421
Tin	37,924	23,354
Other minerals	27,578	36,029
Totals	£5,170,813	£5,045,108

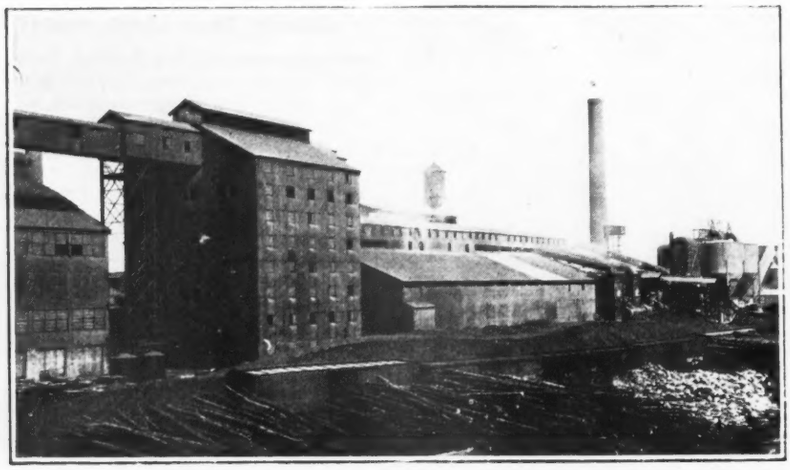
The prospectus of the Tambo Tin Mining Co., Ltd., has been published. The company's proposed capital is £90,000, and 132,000 shares of 5s., fully paid, are now offered to the public. The property is situated on portion A of the farm Tambootieboom, No. 677, in the Potgietersrust district. It has been examined and reported on by W. G. Holford, W. H. Jones, H. Rose-Martin, C. W. Massey, and Oliver King. The directors are F. F. Hathorn, H. R. Marshall, A. D. Hodgson, R. G. Wehrley, and W. H. Carlin. The secretary of the company is V. L. Andersson of Johannesburg.

Tin prospects in South West Africa are said to be good. H. P. Smit, secretary for South West Africa, gave the value of the output in 1919 as £19,700 and for 1926 the figure had risen to £37,440.

The share market in Johannesburg continues active. Consolidated Main Reefs were bought for London in tens of thousands; their price appreciated during the week from 16s. 9d. to 18s. 9d. New Modders rose from 113s. 3d. to 117s. 9d.; Langlaagte Estates have improved from 22s. to 24s.; T. C. Lands rose from 57s. 6d. to 63s.; Potgietersrust platinums have remained at about 9s. 9d. per 5s. share.

Societies, Addresses, and Reports

American Metal Employees Celebrate Twenty-fifth Anniversary of Chrome Plant

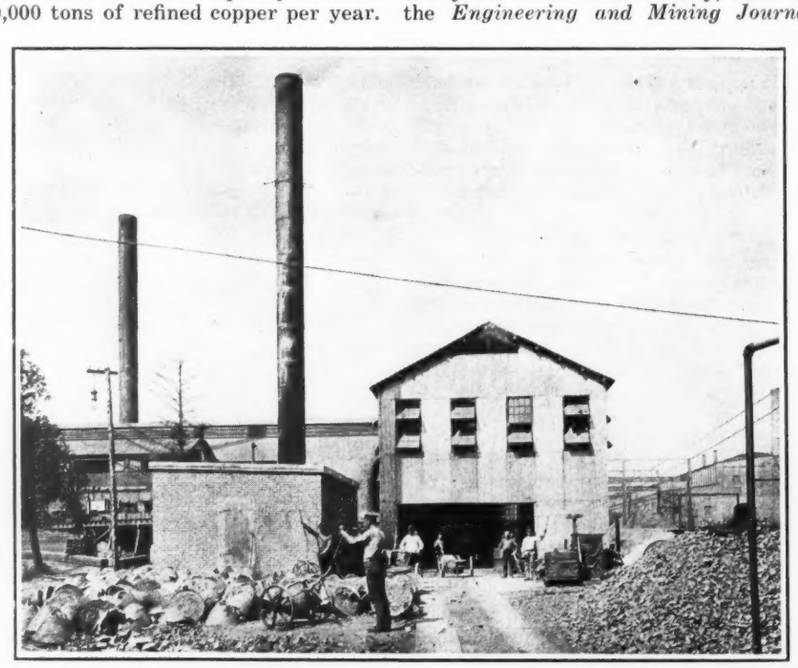


Chrome smelter of the United States Metal Refining Co. at Carteret, N. J., as it appears today. Compare photograph below

Ludwig Vogelstein, chairman of the American Metal Co. and president of the subsidiary United States Metal Refining Co., was the host, on April 2, at a celebration of the twenty-fifth anniversary of the starting of operations of the Chrome copper refinery at Carteret, N. J. The affair was attended by about 300 present and former employees of the company, who gathered at the Robert Treat Hotel, in Newark, N. J. The excellent dinner was followed by a program of music and a few short addresses. Otto Sussman, vice-president of the American Metal Co., promised Mr. Vogelstein that he would receive a silver and bronze plaque bearing a reproduction of the Chrome plant as a memento of the occasion. Unfortunately the jewelers had not been able to finish the work in time for presentation.

Mr. Volgelstein presented gold watches to the following men in token of the appreciation of the company for long service, each of them being veterans of twenty-five years' service: Joseph E. Edwards, circulator in the tank house; Charles E. Bennett, in charge of first-aid and workmen's compensation; and Albert Hillyer, master mechanic. The death of Jacob Roth, cashier for the company, on March 29, prevented him from receiving a watch. At the speakers' table were the following, each of whom either is or has been an official of the company: Lawrence Addicks, Charles H. Aldrich, Heath Steele, Berthold Hochschild, Otto Sussman, Ludwig Vogelstein, Ernest G. Hothorn, Herman Prosser, Ambrose G. Todd, Ralph W. Deacon.

In 1901 Captain J. R. De Lamar and Mr. Vogelstein organized a company to erect the smelter and refinery which was known as the De Lamar Refining Works. The plant started operations about a year later, this being the date commemorated by the dinner last week. In 1906 Captain De Lamar sold his majority interest to the United States Smelting & Refining Co., Mr. Vogelstein and his associates retaining the remaining interest. Meantime the name had been changed to the United States Metals Refining Co. In 1919 Mr. Vogelstein and the American Metal interests acquired the shares held by the U. S. Smelting & Refining Co., and the plant has since been operated as part of the American Metal Co.'s enterprise. Great progress has been made in the last few years toward modernizing the plant and increasing the output. The accompanying photographs show in a striking manner the change that has taken place since the plant was constructed. The capacity is about 240,000 tons of refined copper per year.



In 1902 the chrome smelter looked less imposing than it does in the modern photograph at the top of this page

Mr. Spurr Resigns as Editor

Present Staff, with Long Experience, Will Carry On

J. E. Spurr, editor of *Engineering and Mining Journal* since 1919, has tendered his resignation, effective with this issue. E. H. Robie, assistant editor since 1919, has been appointed acting editor. A. H. Hubbell, managing editor for the last five years, becomes associate editor. A. B. Parsons, assistant editor, is promoted to associate editor. Comment on Mr. Spurr's editorship will be found in an editorial in this issue.

Mr. Robie was graduated from the University of Michigan in 1911 and at once entered the research laboratory of the Cochrane Corporation, Philadelphia. In 1913 he went with the Canadian Copper Co., working first at the Cobalt silver reduction plant and then in various departments of the copper-nickel smelter at Copper Cliff. In 1916 he took an extended trip through the smelting districts of Arizona, Utah, Montana, and British Columbia, studying smelting problems.

After the Canadian Copper Co. was merged with the International Nickel Co., Mr. Robie was put in charge of experimental work in concentration, subsequently taking charge of sampling as well. In 1919 he joined the staff of *Engineering and Mining Journal*, and for the last seven years, in addition to responsibility for metallurgical matters, has been in charge of the market section of the paper.

Mr. Hubbell is a graduate of Columbia School of Mines, and served successively as mining engineer with the Tennessee Copper Co.; in several capacities in various Colorado and Utah camps; on phosphate examination in Florida; and with the Socorro mines, Mogollon, N. M. For two years he was on the staff of the South Utah Mines & Smelters, at Newhouse, Utah, and then after a commercial connection of two years in New York City, came to the *Engineering and Mining Journal*

in 1917. He has been managing editor since 1922.

Mr. Parsons was graduated from the Utah School of Mines in 1909, and saw service in various capacities at Goldfield and Eureka, Nev., and with the Utah Copper Co., at Garfield. For four years he was superintendent for the Candor Mines Co., operating what was then believed to be the only profitable gold mine in North Carolina. He returned to Utah, where he remodeled the cyanide plant of the M. & P. Gold Mining Co., and then went to Upper Burma as smelter foreman for the Burma Mines, Ltd. He was efficiency engineer for the Butte & Superior Mining Co. for two years and then joined the staff of the *Mining & Scientific Press* in 1920, coming to the *Journal* when the two papers were consolidated.

Eight Fellowships Offered by Carnegie Tech.

In co-operation with the Pittsburgh Experiment Station of the U. S. Bureau of Mines, eight research fellowships in mining and metallurgy are offered by the Carnegie Institute of Technology during the coming year. According to the announcement, the fellowships are open to the graduates of colleges, universities, and technical schools who are properly qualified to undertake research investigations. Each fellowship carries a stipend of $750 paid in ten monthly instalments. The period of each fellowship will be from Aug. 15, 1927, to June 15, 1928. The purpose of these fellowships, it is announced, is the solution of problems which are of special importance to the mining, metallurgical, and allied industries. Among the subjects already suggested for investigation during the coming program are the following:

Origin and Constitution of Coal: The determination and separation of coking constituents of coal; comparison of methods of determining the oil and tar yields of coal; the composition of low temperature tar.

Coal Mining: Determination of cost and efficiency of storage-battery locomotive haulage in comparison with trolley locomotive haulage; study of methods in blasting coal.

Utilization of Coal: Correlation of fusing temperature of coal ash with clinker formation in furnaces; study of physical properties of coke in relation to domestic heating.

Mine Safety: Study of relation of fineness of particles to inflammability of coal dust; a study of the mechanism of spontaneous combustion and prevention of gob fires; survey of relative tendency of various coals to fire spontaneously.

Physical Chemistry of Steel Making: Distribution of iron oxide between slag and metal; formation and identification of inclusions; rate of elimination of inclusions; viscosity of open hearth slag; equilibrium between manganese, iron and sulphur; study of abnormality of case carburized steels.

Application blanks for fellowship appointments can be secured by writing the Secretary, Mining and Metallurgical Advisory Boards, Carnegie Institute of Technology, Pittsburgh, Pa.

Will Report Geneva Conference for American Industry

In order to give American industrialists and engineers first-hand information on the deliberations and conclusions of the international Economic Conference at Geneva, the McGraw-Hill Publishing Company is sending Edward J. Mehren, one of its vice-presidents, to the meeting. He will sail on the same ship with the American delegates and experts on April 20. Mr. Mehren will report his observations in *Engineering and Mining Journal*. He will also cover in articles in this paper summaries of the reviews, made at the conference, of the economic positions of the principal countries of the world.

Edward J. Mehren

Mr. Mehren has a broad knowledge of American industry and engineering. Joining the staff of *Engineering Record* more than twenty years ago, he became in turn editor of *Engineering Record*, editor of *Engineering News-Record*, and vice-president and chairman of the editorial board of the McGraw-Hill Publishing Company. In his editorial travels he has covered engineering and industrial developments in every part of the United States, in eastern Canada, and in the leading countries of Western Europe. His general connection with the McGraw-Hill papers and contact with the fields they represent has given him a broad knowledge of American industrial and engineering problems and methods. This will be the background he takes to Geneva.

In addition to his experience gained through his editorial and publishing work, Mr. Mehren was at one time manager of The Emerson Company, and was associated with Harrington Emerson in the height of the "efficiency" movement, thus securing an intimate insight into management technique. He was one of the organizers of the National Association of Corporation Schools and of the wartime Highway Industries Association. He has been a director of the New York Building Congress, and is a director of the American Arbitration Association, and chairman of the arbitration committee of the American Society of Civil Engineers.

Mr. Mehren's ability as a public speaker makes him much in demand for meetings of industrial and engineering associations and societies.

Mining Program Planned by Safety Council

Discussion will dominate the sessions of the Mining Section of the National Safety Council on Sept. 27 to 29, so that the experiences of those present will be made available for all attending the meeting. "Statistics and Their Effect on Accident Prevention" will be presented by H. G. Hensel, safety director, Youngstown Sheet & Tube Co., Chicago, Ill. Written discussion will be presented by W. W. Adams, U. S. Bureau of Mines, Washington, D. C., and R. V. Ageton, Tri-State Zinc & Lead Ore Producers' Association. R. D. Hall is scheduled to make a review of the work of the Mining Section since its inception, as an introduction to a general consideration of the future work of the section. A luncheon will follow with J. T. Ryan, Mine Safety Appliances Co., Pittsburgh, Pa., as chairman.

At the second session McHenry Mosier, superintendent of mines, Phelps Dodge Corporation, Morenci, Ariz., will discuss "Foremanship Training Conferences and Their Bearing on Accident Prevention"; Joseph M. Hall, regional agent, Federal Board of Vocational Education, Washington, D. C., and C. A. McDowell, assistant manager, Pittsburgh Coal Co., Pittsburgh, Pa., will further discuss the subject. Eugene McAuliffe, president, Union Pacific Coal Co., Rock Springs, Wyo., will present a paper entitled "Accident Prevention in Its Broader Phases." A luncheon will follow with A. J. Curtis as chairman. In this luncheon the Quarry and Cement Sections will participate.

The third session will be opened by Dr. F. V. Meriweather, U. S. Bureau of Mines, Miami, Okla., with a paper entitled "Effects of Mine Dust on Health." J. L. Boardman, safety director, Anaconda Copper Mining Co., Butte, Mont., and Daniel Harrington, chief mining engineer, research division, U. S. Bureau of Mines, Washington, D. C., will further amplify the subject.

Discussions will follow on ventilation, blasting, haulage, and any other subjects that members may care to introduce. Frank Pollock, safety engineer, Oliver Iron Mining Co., Eveleth, Minn., will lead this discussion.

The meeting of the National Safety Council of which the foregoing sessions will form a part will be held at Chicago, Sept. 26 to Oct. 1.

Business Leaders to Speak at Washington Meeting

A distinguished list of speakers, including President Coolidge and Herbert Hoover, Secretary of Commerce, will address the fifteenth annual meeting of the Chamber of Commerce of the United States which will be held in Washington, May 2 to 5. This national gathering of business leaders from all parts of the United States has been called for the purpose of discussing the important economic changes that have taken place in the business life of the nation during the past few years. The discussions will center around the major topic, which is "The New Business Era."

People You Should Know About

T. Field has left Arizona for an extended trip to South Africa.

W. R. Wade has been appointed assistant general manager of the Minas de Matahambre, in Cuba.

Charles A. Mitke has just returned to Phœnix, Ariz., from Cuba, where he was called on professional business.

Henry Hanson, metallurgical engineer of Toronto, Canada, was a recent visitor to Oakland, Calif., where his family is residing.

E. G. Lawford has resigned from his position as mine foreman with the Santa Gertrudis company at Pachuca, and is now in London.

H. W. C. Prommel, consulting geologist, has returned to Denver after a business trip to Los Angeles, San Francisco, and Salt Lake City.

W. H. Seaman has been appointed manager of the Ankerite gold mine, Porcupine, Ontario.

E. H. Clifford, consulting mining engineer to the Chartered Company (Rhodesia), with his wife, sailed for England from Capetown on March 11.

S. P. Howell, explosives engineer with the U. S. Bureau of Mines, talked to the safety engineers of Miami, Okla., on March 30, on the prevention of accidents.

J. O. Elton, manager of the International Smelting Co., Salt Lake City, Utah, recently visited the Walker mine, in California, one of the properties operated by the International.

P. A. Bergh has recently secured the control and management of the Union Phosphates, Ltd., to work the deposits in the Malmesbury and Darling districts of the Cape Province, in the Union of South Afrcia.

J. E. Spurr, with Mrs. Spurr, leaves New York today (April 16) for a six weeks' recreation trip through northern Europe. His permanent address for the present will be at his home, 7 Edgewood Park, New Rochelle, N. Y.

Dr. Percy Wagner, the well-known South African geologist, has resigned from the government service and accepted the post of consultant to the Mineral Exploration Co., Johannesburg, recently formed by G. A. E. Becker and associates.

R. G. Segsworth, of Toronto, who has been appointed a director of the Dome Mines, Ltd., of South Porcupine, Ont., has been associated with the mining industry since the early days of the Cobalt camp. He is strongly in favor of an aggressive exploration campaign at depth.

C. B. Brodigan, manager of the Brakpan Mines, Ltd., who has been with the company since the sinking of its first shafts, will soon leave Johannesburg on a six months' tour of Europe. **C. K. Pitt** will be acting manager during the absence of Mr. Brodigan.

Fred G. Brown, for many years identified with mining concerns in northern Queensland, Australia, is visiting the United States on a mission for the Queensland Tin Co., Ltd.

H. D. Keiser has joined the editorial staff of *Engineering and Mining Journal*. Mr. Keiser formerly was a member of the U. S. Geological Survey, stationed at Miami, Okla. Prior to his assignment to the Tri-State district, Mr. Keiser spent two years working in various mining camps, including those at Broken Hill, New South Wales, Australia; Queenstown, Tasmania; and

H. D. Keiser

Johannesburg, South Africa. He holds the degree of civil engineer from Lehigh University, and that of B.S. in mining from The Pennsylvania State College. Mr. Keiser will be in charge of the news section of *E. & M. J.* His article on "Re-treating Coarse Tailing in the Tri-State District" appeared in the April 9 issue.

F. D. Long, from the Consolidated mines, and **A. Veal**, shift boss on the Nourse mines, on the Rand, have left Johannesburg, having received appointments in Spain, with **G. Hildick Smith**, who is supervising railway construction in that country for the Central Mining & Investment Corporation, of London.

Neilson Poe, of Princeton, N. J., formerly connected with mining operations in Nevada, has been elected a director of the Basin Montana Tunnel Co. Mr. Poe recently visited Butte and Basin to make an inspection of the properties of the company, located on Comstock Hill about two miles east of Basin.

Gerald FitzGerald, of the Alaskan Branch of the U. S. Geological Survey, left Fort Yukon, Alaska, with all his equipment, on March 30 for a season's work on the East Fork of Chandalar River and in the adjacent regions. Until the end of the field season in September Mr. FitzGerald will be out of reach of communication.

Dr. H. T. Mann has been appointed associate professor of petroleum engineering at the Massachusetts Institute of Technology. Dr. Mann is a graduate of the Rolla School of Mines, where he taught mining engineering and metallurgy for a number of years. Later he taught in the Butte School of Mines. Three years ago Dr. Mann took the degree of doctor of science and metallurgy at M.I.T.

Obituary

John R. Farrell, mining engineer, a graduate of the University of California, died on April 6. He was one of the first American engineers to go to the Belgian Congo.

Thomas Hayward, miner, soldier, and adventurer, died recently in Queensland, Australia, at the age of seventy-five. After having as a young man fought in the Kaffir wars in South Africa, he went to Australia forty years ago, and in the years following he visited nearly every gold field in that country, as well as in New Guinea and other islands of Australasia. In 1910 Mr. Hayward went from Western Australia to northern Queensland, where he engaged in mining for wolfram and the other metals that abound in that part of the Australian Commonwealth. He was a brother of the famous English cricketer.

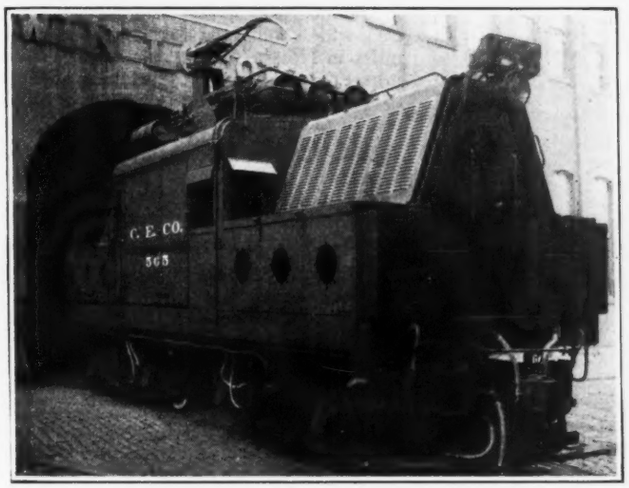
Jack Harrington, of Miami, Ariz., known throughout the mining regions of the southwest as "Slasher" Harrington, because of the rapidity with which he sunk mine shafts, was instantly killed on the Bisbee-Naco Road, at Bisbee, Ariz., on April 2, when his automobile turned over. In the early days of hand-drilling contests in the West, Harrington took part in several championship events and was recognized as one of the fastest drillers in that section of the country. He established a shaft-sinking record at the Old Dominion mine, in Globe, and later at Miami. He also sunk a shaft for the Kay Copper Co. to a depth of 1,200 ft., and one for the Sunnyside Consolidated Mines Co. at Oatman. Recently he was awarded a contract for the sinking of a shaft in Gold Gulch, in the Warren district, for the United Verde Extension Mining Co.

Leon Philip Feustman, vice-president of the Worthington Pump & Machinery Corporation, died on April 7, in New York. Mr. Feustman was sixty-six. He was educated at the University of Pennsylvania, and went to Leadville, Colo., soon after the mine discoveries at that place, where he found employment as a chemist. In 1888 he went to Mexico for the Consolidated Smelting & Refining Co., later becoming resident manager of all of that company's Mexican properties. In 1900 Mr. Feustman came to New York to the home office of the above named company, with which he was associated until 1903, when he assumed the vice-presidency of the Power & Mining Machinery Co. Four years later he was made vice-president and general manager of the International Steam Pump Co., with which the Power & Mining company was merged, making it the largest organization of its kind in the world at that time. Subsequently, the company was reorganized as the Worthington Pump & Machinery Corporation, with Mr. Feustman occupying the same position as before. Mr. Feustman was a member of the American Institute of Mining Engineers, the National Geographic Society, and of many other societies, and of the Engineers', Field, Lawyers' and Machinery clubs of New York. His wife, a son, and a daughter survive.

New Machinery and Inventions

Combination Line and Battery Locomotives Have Many Special Features

Six 76-ton combination line and storage-battery locomotives were completed for the Chilean Exploration Co. in the last month of 1926 for use in copper-mining operations near Chuquicamata, Chile. The company intends to determine by trial the saving to be made through electrifying its mine haulage. For this reason the six locomotives have many special features which would not all be incorporated in later locomotives, but which are included in these trial locomotives to decide which features best meet the conditions found on this property. These special features are: side-arm trolley, third-rail shoes, and a large storage battery and motor-generator set.



This 76-ton locomotive is equipped with side-arm trolley, third-rail shoes, a storage battery and a motor-generator set

The side-arm trolley consists of a shoe or horn mounted on a wooden pole extending out from the roof of the cab some 5 ft. The pole can be swung out or in at will by its air cylinder, which, in turn, is fed by two magnet valves and is raised against an off-side trolley wire by a spring. The purpose of the off-side trolley is to permit operations above the track without danger of contact with the trolley wire. Two side-arm trolleys are mounted on the roof of the locomotive cab at diagonally opposite corners.

Four third-rail shoes are provided for operation on main haulage tracks where conditions warrant the building of a permanent structure. These shoes are electro-pneumatically operated and, when not in use, are raised to avoid obstructions.

A 630-ampere-hour, 230-volt storage battery is provided for operation on the *ripio*, or tailings dump, where neither permanent side trolley nor third rail is practicable, due to the continual change in track location.

The storage battery is charged from a 600-300 volt d.c. motor-generator set of 30 kw. capacity carried on the locomotive. Control of this motor-generator is entirely automatic, and the battery-charging current is regulated in accordance with its state of charge in the most approved manner, by a voltage regulator which limits the initial charging current to a safe maximum value and tapers down the charging current as the charge progresses to a gassing point. When the battery is fully charged the motor generator is shut down through the operation of an ampere-hour meter equipped with contacts which open under this condition and prevent further operation of the motor-generator set until the battery has been discharged to a predetermined point.

A 15-gal. water tank complete with hose and fittings is provided in each battery compartment to carry water to replace evaporation, which is very great on this property, as the altitude is 9,000 ft. above sea level and the air is extremely dry.

The locomotives have double-end multiple-unit control and a bus line. The master controllers are equipped with "dead man" handles. Control is three speed: series, series-parallel, and parallel. One of the special conditions which made three-speed control necessary was the requirement of moving a 24-car train continuously at a speed of 27 ft. a minute for twenty minutes under an ore bridge which loads the train with tailings in one continuous operation. This was a very unusual condition in locomotive design, due to the long period of operation on the grid resistance.

The air-brake equipment is Type 14-EL and the two compressors are 50-cu.ft. machines with 300-600 volt motors for operation from either the battery or the line.

In the engineman's compartments are gages, meters, and all necessary switches. Change-over between trolley, battery and shoe, as the power supply, is effected by throwing canopy switches to the desired positions. Sander, shoe, and trolley operations are controlled by push buttons. All circuits are interlocked to prevent false operation.

Precautions Against Dust

The air is so dry at Chuquicamata and the copper ore dust is so dense that totally inclosed self-cooled motors are resorted to, in order to prevent motor trouble from dust.

A rather new design, employing coil springs for anchoring the equalization has been adopted for the locomotive trucks. The center pin is supported on leaf springs. The trucks are articulated.

Couplers are standard M.C.B. and arranged to be swung over to either side of the center line to pull narrow-gage cars using one of the standard-gage rails.

Ratings, weight, and general dimensions of these locomotives are given in the following tables.

Ratings

Totally Inclosed Self-cooled 600-Volt Line

	Hour	Continuous
Horsepower	575	226
Tractive effort, lb.	26,600	6,570
Miles per hour	8.11	12.9
Motor amperes	205	80

230-volt Battery

	Hour	Continuous
Horsepower	185	87
Tractive effort, lb.	26,200	7,250
Miles per hour	2.65	4.5
Motor amperes	205	85

Storage Battery

114 cells Type MVA 41, 630 ampere-hours

Motor Generator

600-300 volts, 30 kw. Type SK

Main Motors

Four type 582-D-6, 600 volts
Maximum tractive effort at 33⅓ per cent adhesion, 50,900 lb.
Maximum safe speed, 35 miles per hour.

Weights

Total weight including sand, lb.	152,770
Mechanical parts, lb.	81,234
Electrical parts, lb.	71,536

Dimensions

Gage	4 ft. 8½ in.
Wheels	36 in.
Width of cab	10 ft. 0 in.
Width over all	10 ft. 7 in.
Length of cab	28 ft. 5 in.
Height of rail to top roof	13 ft. 1 in.
Type of drive	Helical gears
Gear ratio	16:70
Wheel arrangement	B + B

The locomotives described were built by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Co.

Catalogs

Dredges — American Brown Boveri Electric Corporation, 165 Broadway, New York, Bulletin No. 900 on hydraulic dredges and Bulletin No. 901 on floating pipe lines for hydraulic dredges.

Filtering—Filtration Engineers Incorporated, 253 Broadway, New York. "FE Inc Filter Dryer Facts."

Stills — Barnstead Still & Sterilizer Co., Boston, Mass. Catalog A, a handbook of water-distilling apparatus for all purposes.

Market and Financial News

Consolidated M. & S. Earnings Increase to $13,915,262 for 1926

INCREASED production and lower operating costs enabled the Consolidated Mining & Smelting Co. of Canada to increase its earnings and profits in 1926, in spite of considerably lower average prices for silver and all of the base metals that the company produces. After providing for current development, depreciation of plant, and depletion of property, and after adding $100,000 to the pension fund and $193,669 to the fire-insurance reserve, net profits were $13,915,262. The accompanying tables show the profit-and-loss account for the year and a summary comparing financial results during recent years. The steady improvement is remarkable.

The report of S. G. Blaylock, general manager, states that the production figures for 1926 show the following increases over the preceding year: gold, 144 per cent; silver, 52 per cent; lead, 11 per cent; and zinc, 38 per cent. As a consequence of the larger refinery capacity the output of refined lead was increased 21 per cent and of refined zinc 60 per cent.

Continued expansion and betterment is the program. During 1926 the 500-ton Moyie re-treatment plant was completed and put in operation; the Sullivan mill was enlarged to a capacity of 4,000 instead of 3,000 tons per day; the Cottrell plant to serve the lead smelter was virtually completed; and the Dwight-Lloyd plant was doubled in capacity. In the mine heavier rails have been laid in the main haulageways, so that heavier locomotives may now be used and trains of double the old tonnage capacity can be handled. Timbers have been replaced in the haulageway by supports of concrete and steel, and an underground electric station has been installed. All of this has helped to make possible a marked reduction in the cost of mining. A new 3,000-kw. generator plant run by steam turbines was installed at Kimberley as a safeguard against possible shortage of hydro-electric power or for emergency use.

Work now under way includes additions to the zinc plant, designed to increase the capacity by 80 tons; the erection of a plant to recover cadmium; the building of a drying plant for zinc-plant residues; addition of a coarse crushing plant at the St. Eugenie mill; installation of a 1,500-kw. electric furnace plant; and building a 50-ton sulphuric acid plant.

The West Kootenay Power & Light Co., a subsidiary, completed during the year the installation of the third 20,000-hp. hydro-electric power plant. Though the present capacity of the power plants at Bonnington Falls is 90,000 hp., the development of 60,000 hp. in addition has been authorized, at an estimated expenditure of $4,200,000. The statistics that appear in the table at the left show the tons of ore treated and the total production of the Kimberley and Tadanac plants from 1914 to date and in 1926.

Profit and Loss Account, 1926—Consolidated M. & S. Co.

To ores, metals, and smelter products on hand and in transit at Dec. 31, 1925	$5,009,939
Customs ore, copper, and bullion purchased	4,349,581
Freight and insurance on company ores	764,936
Mining, smelting, and general expense	11,124,961
Development expense	595,608
Depreciation of plant and equipment	1,354,232
Provision for depletion of mineral properties	523,881
Interest—bank and general	23,557
Director's fees	6,130
Fire-insurance reserve	193,669
Sundry items written off	4,321
Employees' pension-fund reserve	100,000
Balance profit before provision for income taxes	13,915,262
	$37,966,083
By sales of smelter products	$32,650,727
Ores, metals and smelter products on hand and in transit at Dec. 31, 1926	4,836,183
Revenue from investments	361,469
Rents royalties and sundries	117,703
	$37,966,083

Production Record

	1914 to Date	1926
Tons ore treated	11,184,578	1,354,821
Gold, oz.	2,134,926	50,075
Silver, oz.	54,510,767	7,178,817
Lead, lb.	1,478,155,775	262,105,431
Copper, lb.	124,212,276	21,263,988
Zinc, lb.	562,837,364	135,092,654

Statistical Notes

Iron Cap Copper Co., operating in the Copper Hill district in Arizona, produced 3,897,780 lb. of copper and 103,601 oz. of silver during 1926, compared with 4,566,501 lb. and 149,513 oz. in the preceding year. The grade of the ore was much lower. Profit before charging depreciation was $73,971, and after deducting $53,377 depreciation, was $20,593. The company owns a large interest in the Mineral Products Co., which operates feldspar mines and mills in North Carolina, and these holdings are counted on to produce revenue to offset the exhaustion of the copper ore reserves in Arizona.

United Verde Extension Mining Co., operating in Arizona, in March produced 2,622,908 lb. of copper, against 2,303,758 in February and 3,567,064 in March, 1926.

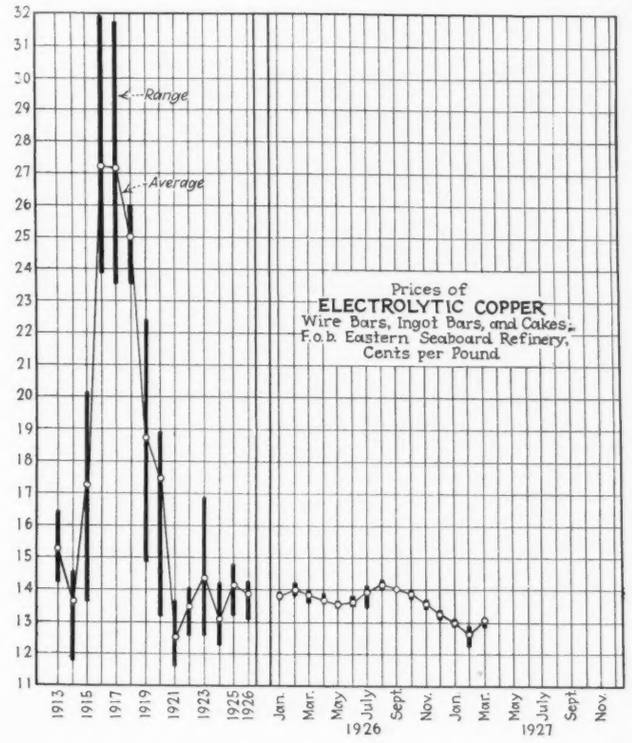
Gladstone Mountain Mining Co. realized an operating profit of $92,411 from the mining of 1,146 tons of sulphide ore, averaging 74.61 per cent lead; and 3,611 tons of carbonate ore, averaging 22.62 per cent lead, according to the report for the year 1926. Net smelter returns were $181,159. This small company pays no salaries to its officers other than the secretary, and no office rent. The accompanying expense account shows the distribution of costs. In explanation of the high cost of hauling ore the report explains that heavy rains and soft roads made the worst year in history in this respect:

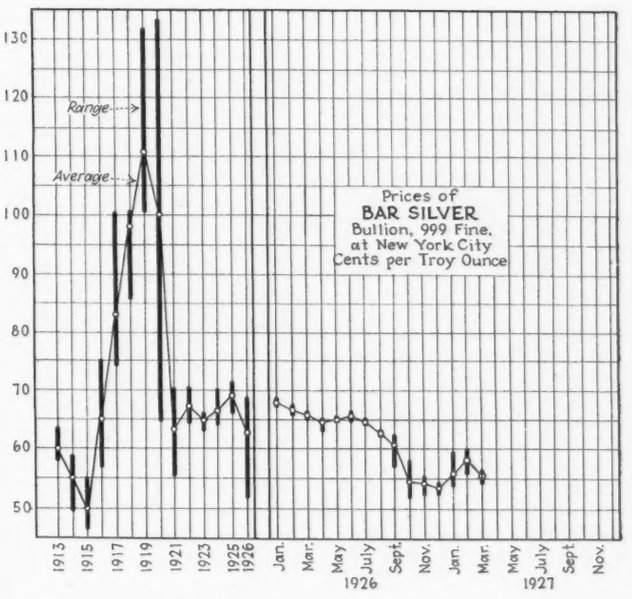
Mining:		
Superintendent	$3,644.00	
Labor	34,583.42	
Supplies—mine	6,695.61	
Assaying	563.35	
Industrial insurance	1,065.51	
Boarding men	9,525.83	
Miscellaneous	223.05	
Auto expenses	461.48	
Hospital	26.45	
Traveling expenses	139.68	
		$56,928.38
Hauling ore		26,498.48
Overhead:		
Office expenses	$14.89	
Telephone and telegram	22.76	
Postage—printing and stationery	464.76	
Miscellaneous	82.60	
Auditing	325.00	
Dividend expenses	200.00	
Traveling expenses	156.15	
Corporation license	50.00	
Exchange on checks	90.53	
Advertising	49.20	
Transfer and registration	274.53	
		$1,730.42
Secretary's salary	1,800.00	
Taxes paid	1,371.13	
Taxes accrued	1,400.00	
Depreciation	2,189.41	
		$8,490.96

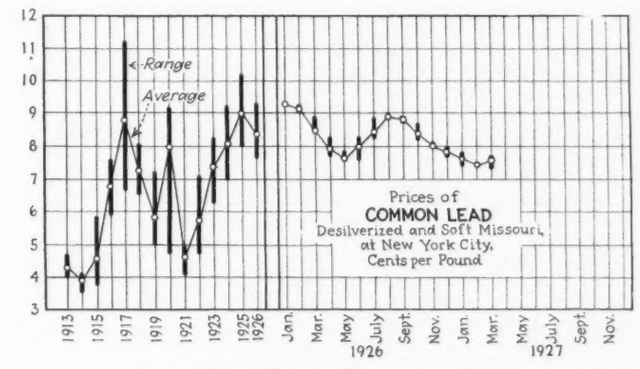
Comparative Financial Statements—Consolidated M. & S. Co.

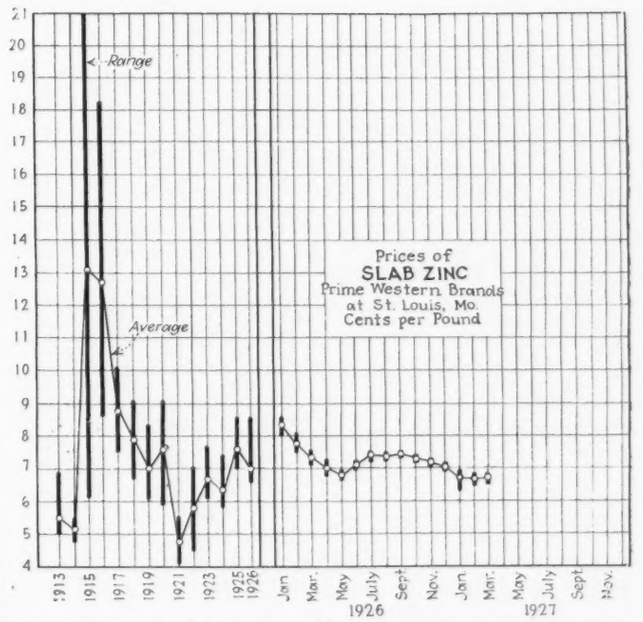
	1926	1925	1924	1923
Sales	$37,966,083	$33,572,004	$19,077,776	$11,229,163
Balance after expense, depletion and depreciation, etc.	22,149,150	16,002,661	6,173,327	3,755,014
Net income	$12,627,398	$10,780,639	$3,278,904	$1,681,162
Dividends	5,078,492	3,238,053	641,043	632,022

Metal Price Curves

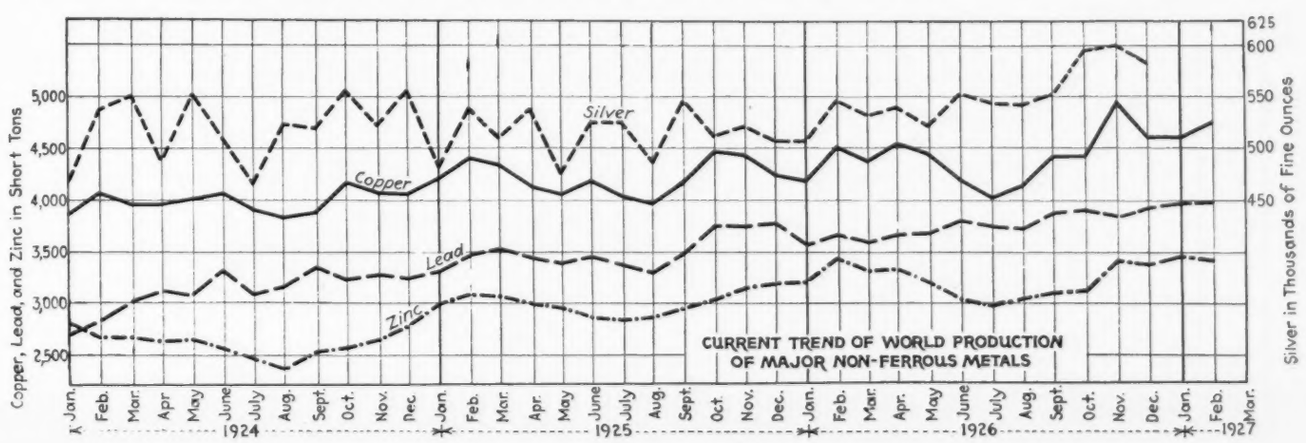








THE curves below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output, according to latest estimates of the American Bureau of Metal Statistics. The figures represent countries that produced in 1924 and 1925 about 97 per cent of the world's output of copper; 78 per cent of the lead; 87.5 per cent of the zinc; and 81 per cent of the silver. Figures now being published by the Bureau include a larger proportion of the world output than those stated. However, until these have been in effect for a sufficient period of time to give a "history" for purpose of comparison, it is thought desirable to make the necessary adjustment in the data and extend the curve on the basis that has been in vogue for two years.



Review of Current Statistics

By A. B. Parsons
Assistant Editor

AVERAGE PRICES for copper and lead were higher in March than in February, copper, with an advance from 12.682 to 13.079c., showing particular improvement. These, together with nominal advances in zinc and tin, served more than to offset a decided decline in silver, from 57.898 to 55.306c., and to lift the *Engineering and Mining Journal* Weighted Index of Non-Ferrous Metal Prices from a hair's breadth above the 1922-1923-1924 base line to 100.84c.

As appears in the graph on the page opposite this, the Index has had a habit of following trends with peculiar consistency. No erratic months are shown thus far; but it seems not unlikely that April may prove the exception. As this is written, copper, lead, and zinc all are considerably below the averages of March; and unless a definite change for the better develops soon, the index number for April may reverse the slight upward trend established in March.

Comparison of Index with General Commodity Price Favorable

Looking back over the record it is necessary to revert to the summer of 1924 to find a level lower than the current price of lead. The same applies to zinc except for the brief sag to 6.375c. in January of the present year. In considering the status of the metals as a group, however, it is appropriate to compare metal prices with the general level of commodity prices. In the graph near the bottom of this page the *E. & M. J.* Metal Index is plotted in conjunction with the index of the Bureau of Labor Statistics for all commodities. The comparison is made on the assumption that the three-year period from 1922 to 1924 reflects a fair "normal" for both indexes. On this basis it is evident that metals are not faring so badly. If the upward bulge in the metal index in the summer of 1926 is overlooked the two curves have roughly paralleled each other on their downward course since December, 1925, with the advantage definitely on the side of the metals.

Just how far lowered costs of mining and treating ores lag behind lower commodity prices is difficult to estimate; but certainly lower prices ultimately are reflected in production costs, and offset in a measure the shrinkage in income consequent upon lower prices realized for metals. The question arises whether the metals should be carried by the momentum of the general downward price swing; or, in other words, could they be held up by a policy on the part of mining companies of adjusting production to synchronize more closely with consumption than has been done in recent months? The accompanying curves of tonnage statistics show an uninterrupted increase in the stocks of copper, lead, and zinc at the plants of producers since last September. This unquestionably has played into the hands of the consumer and has been a factor in the depressing of prices. Many companies that mine each of the metals have declared their intention of curtailing output. Some of them doubtless are pursuing this policy; but others are increasing output instead of decreasing. The net result in respect to copper was a decrease of 9 per cent in the rate of smelter output in North and South America in March.

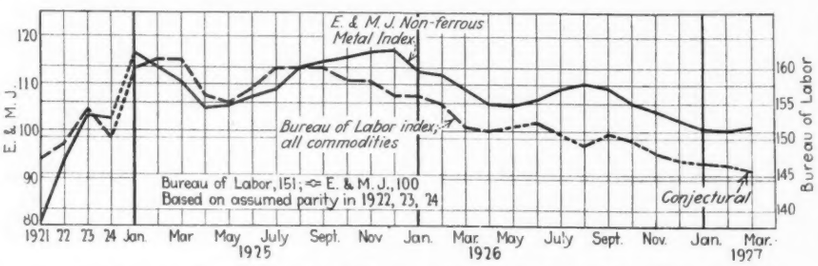
E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74

	1925	1926	1927
September	114.66	109.27	
October	115.64	106.20	
November	116.69	104.21	
December	114.15	102.31	
January	116.38	112.66	100.46
February	113.50	111.91	100.01
March	110.20	108.95	100.84
Average first three months	113.36	111.17	100.44

The record-breaking period of copper buying in February was followed by the dullest month of recent years so far as the domestic market is concerned, and this deadly dullness has persisted into April. Producers maintain that very active buying must start soon and they look for some improvement in prices.



Comparison of E. & M. J. Non-Ferrous Metal Index with All-Commodity Price Index of Bureau of Labor Statistics

During March the American Smelting & Refining Co. did something that is exceedingly rare in the adjustment of its official price for lead. Early in the month two increases were made on successive days, raising the price to 7.65c. from the 7.40c. that had been reached after a steady decline of many months. It looks as though the Smelting company misjudged the situation, as, within a month, reductions have been made that have taken the price to 7.25c., or below the former low.

Consumption of metals continues generally good, but there appears to be one point of special weakness for each of the major metals: wire business is slack for copper; storage-battery makers are inactive buyers of lead; and galvanizers display little interest in zinc.

Two small declines affected the Weighted Index of Non-Metallic Mineral Prices, barytes and phosphate each easing slightly. An advance in the prices for Rhodesian asbestos and in some grades from the Quebec mines took place during the month, but they did not have a material effect on the index number.

"Coppers" Lead Decline of Mining Company Shares During March

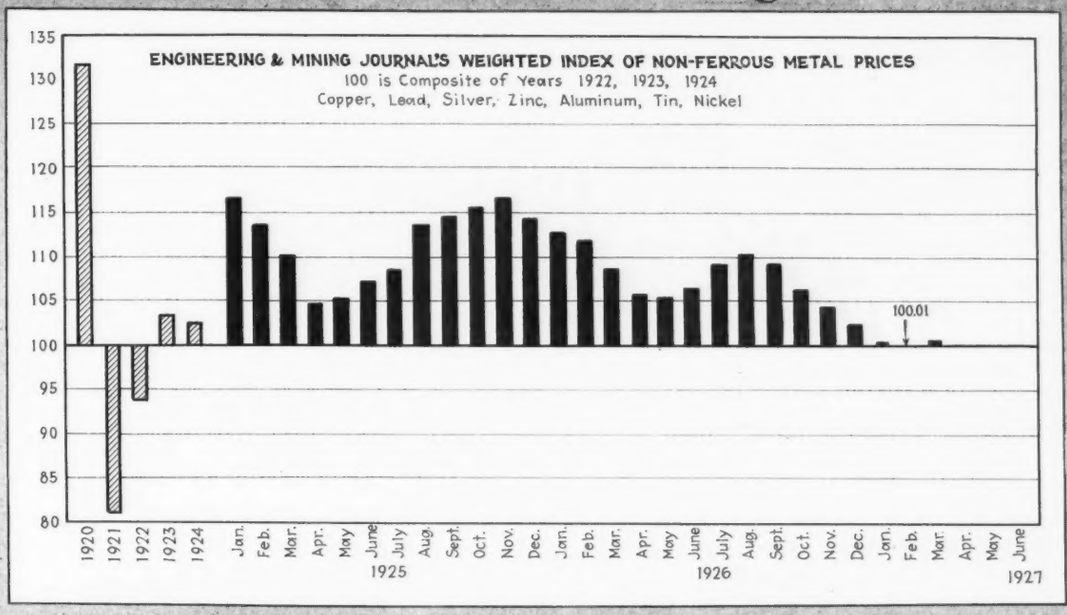
Mining-company shares did not participate in the advance in the general list of stocks as they did in February. At the same time each of the indexes is well above the levels of March, 1925 and 1926. In the mining-smelting-manufacturing group four advances missed offsetting three declines by a small margin. Anaconda, A. S. & R., and International Nickel declined. Anaconda probably went along with the "coppers"; the other two reacted a little after advances verging on "sensational" during February. National Lead continued to climb, passing $200 at one time but ending the month at about $192. Reports of record earnings and confirmation of the plan to distribute a stock dividend are responsible. United States S. R. & M. and American Metal made some progress toward recovering ground recently lost.

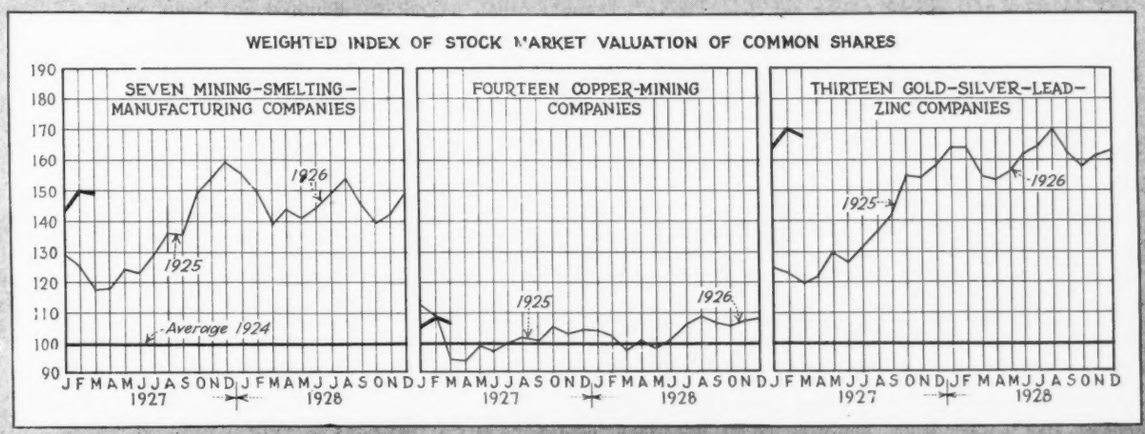
In the copper group the only exceptions to the general decline were Chile, Old Dominion, and Quincy. Probably some liquidation following the rather disconcerting drop in the market for the metal during February was responsible. Inspiration was the largest sufferer.

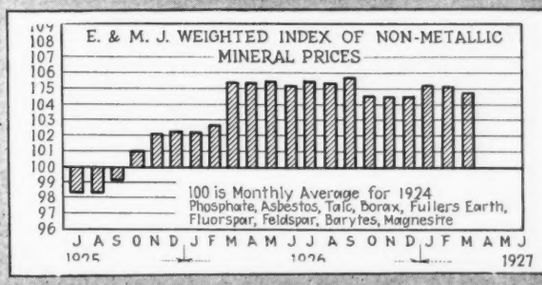
Ups and downs marked the course of the stocks in the miscellaneous group. Hollinger and Lake Shore, Ontario gold properties, eased in spite of excellent reports. This is in accord with a general reaction in Ontario-Quebec issues, which in the opinion of most engineers had been pushed too high in a top-heavy market. The Utah lead-silver stocks weakened slightly, Utah-Apex, Silver King Coalition, and Tintic Standard each being off. Hecla, in the Coeur d'Alene district of Idaho, on the other hand, recovered a large part of the decline suffered in February. Other stocks in the group to advance were Cerro de Pasco and Homestake.

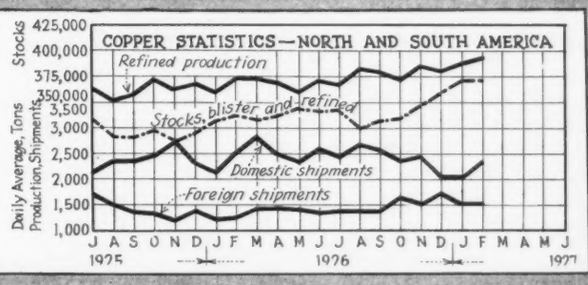
February statistics reveal an upward tendency in world's production of copper and lead and a small decline from the high point reached by zinc.

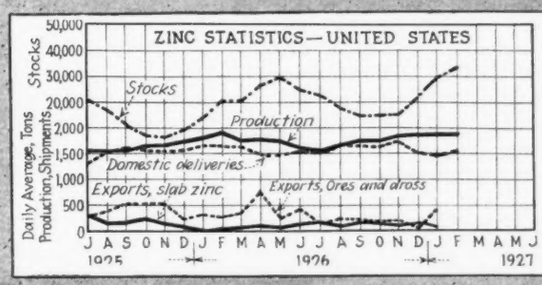
E.&M.J. Statistics of the Mining Industries

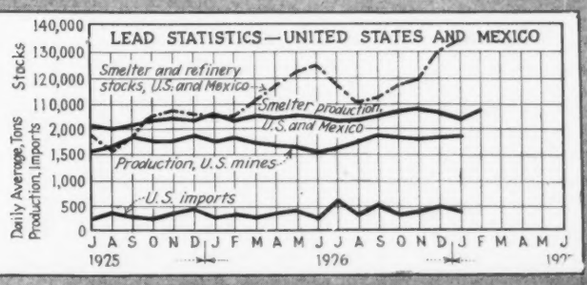

ENGINEERING & MINING JOURNAL'S WEIGHTED INDEX OF NON-FERROUS METAL PRICES
100 is Composite of Years 1922, 1923, 1924
Copper, Lead, Silver, Zinc, Aluminum, Tin, Nickel
100.01
1920 1921 1922 1923 1924 Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1925
1926
1927


WEIGHTED INDEX OF STOCK MARKET VALUATION OF COMMON SHARES
SEVEN MINING-SMELTING-MANUFACTURING COMPANIES
FOURTEEN COPPER-MINING COMPANIES
THIRTEEN GOLD-SILVER-LEAD-ZINC COMPANIES
1925
1926
Average 1924
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928


E. & M. J. WEIGHTED INDEX OF NON-METALLIC MINERAL PRICES
100 is Monthly Average for 1924
Phosphate, Asbestos, Talc, Borax, Fullers Earth, Fluorspar, Feldspar, Barytes, Magnesite
J A S O N D J F M A M J J A S O N D J F M A M J
1927


COPPER STATISTICS—NORTH AND SOUTH AMERICA
Stocks
Daily Average, Tons Production, Shipments
Refined production
Stocks, blister and refined
Domestic shipments
Foreign shipments
J A S O N D J F M A M J J A S O N D J F M A M J
1925
1926
1927




LEAD STATISTICS—UNITED STATES AND MEXICO
Stocks
Daily Average, Tons Production, Imports
Smelter and refinery stocks, U.S. and Mexico
Smelter production, U.S. and Mexico
Production, U.S. mines
U.S. imports
J A S O N D J F M A M J J A S O N D J F M A M J
1925
1926

The Market Report

Copper, Zinc, and Tin Sales Improve

Prices of Most Metals Lower Than a Week Ago, However

New York, April 13, 1927—The long-deferred buying movement in copper showed signs of materializing this afternoon, when a good tonnage was sold at 13c. for Eastern deliveries. Zinc continues quiet at slightly lower prices, though the volume of sales was better than a week ago. Lead perhaps looks the weakest of all of the non-ferrous metals at the moment, business having been poor lately. Tin has been a little lower for spot offerings, and consumers have bought somewhat more liberally for forward as well as prompt. Silver is back to 56¼c. today after having been as high as 57⅛c. Antimony is distinctly stronger, being held at close to 15c.

Copper Statistics Favorable

Business continued quiet in the copper market until today, with practically all sales at 13c., delivered Connecticut. One or two resale lots went for slightly less, and consumers near the refineries also got their customary concessions. Today the statistics appeared, showing a decline in refined stocks at the end of March from 105,020 to 102,637 tons, and of blister from 272,219 to 260,225 tons, rather surprising in the case of blister. The rate of both domestic and export shipments improved by about 4 per cent over February. Refinery production rate decreased by close to 7 per cent, and smelter production by almost 9 per cent. Mine production data are not yet available, but the indications are that the rate of mine production was cut at least 10 per cent in March, a curtailment which, if continued, should be most satisfactory to producers who are trying to prevent the bottom from falling out of the market. The favorable statistics stimulated demand this afternoon, when over 6,000 tons were sold, more than in some entire weeks recently. A large buying movement is overdue and may be getting under way. Two or three producers are already out of the market at 13c., but late Wednesday afternoon plenty of copper was still available at that level. The foreign price was reduced on April 12 from 13.65c., c.i.f., to 13.50c. Export demand has been quiet.

Lead Continues Dull

Gradual recession in prices in the St. Louis district has been the feature of the domestic lead market during the week. As early as last Friday sales were made at 6.95c. and yesterday the leading interest reduced its price to that level. Today any reasonable quantity seems available at 6.90c. In New York the market has been unusually quiet, but the American Smelting & Refining Co. has maintained its price all week at 7.25c. and scattering sales at 7.20c. were offset by others that brought a small premium.

Zinc Quiet at 6.40c.

Zinc has gradually weakened during the last seven days, dropping from 6½c., St. Louis, to 6.40c. In fact some offers were made today as low as 6⅜c. Business has been a little larger than last week, but is still below normal. The statistics are not particularly reassuring, showing practically the same rate of production in March as in February; shipments were also at about the same rate as in February, in both months being less than production, so that stocks again increased. April production should be markedly less, owing to smelter curtailments in late March. At present prices, it is felt that zinc is scraping bottom, as ore is only $42 a ton, and at and below that, production is likely to be severely curtailed at the mines. High-grade is nominally lower, at about 8¼c., Eastern deliveries.

American Zinc Institute's statistics, in tons of 2,000 lb., follow:

Stock, March 1	32,938
Produced	56,546
Shipped	53,205
Stock, March 31	36,279
Shipped from plant for export	5,098
Retorts operating, March 31	83,208

Daily Prices of Metals

Apr.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L	St. L
7	12 775	67 375	69.125	7.25	7.00	6 475@6 50
8	12 775	67 00	68.50	7.25	6.95@7 00	6 45
9	12 775	67.25	68 75	7.25	6 95@7.00	6 425
11	12 775	66 625	67 875	7 25	6 95@7 00	6 375@6 40
12	12 775	66 50	67 875	7 25	6 95	6 40
13	12 775	66 675	68 00	7 25	6 90	6 375@6 40
Av.	12 775	66.904	68 354	7.250	6. 963	6 423

Average prices for calendar week ending April 9, 1927, are: Copper, 12.810c.; 99 per cent tin, 67.521c.; Straits, 69.229c.; N. Y. lead, 7.250c.; St. L. lead, 6.988c.; zinc, 6.485c.; and silver, 56.750c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
7	55	55⅝	61¾	309½	299¾	26 7/8	27 7/16	29 11/16	30 3/16
8	54 7/8	55⅜	61	306¾	298½	26 13/16	27 5/16	29¾	30⅛
11	54 11/16	55⅜	61¼	305	297¼	26⅜	27¼	29½	29 13/16
12	54 13/16	55⅜	61¼	303½	296½	26 15/16	27 7/16	29⅝	30
13	54 11/16	55⅜	61¼	305	298	27 3/16	27 11/16	29 13/16	30⅛

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver		Gold London	Apr.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
7	4 85⅛	57⅛	26 9/16	84s11d	11	4 85⅛	57	26⅜	84s11d
8	4 85⅛	56⅝	26¼	84s11d	12	4 85⅛	56½	26 3/16	84s10 7/16d
9	4 85⅛	56	26		13	4 85⅛	56¼	26	84s11½d
					Avg.		56 583		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Prompt Straits Tin at 68c.

Tin buying on the part of consumers has been in moderate volume for May and June, with some for prompt delivery. The price tendency has been generally downward in the domestic market, though a 30-shilling rise in London today stiffened prices here, prompt Straits being sold at 68c.

Silver Steady at 56¼c.

During the last week China and India have operated as both buyers and sellers of silver, with the result that the market fluctuated in London between 26d. and 26⅛d., and in New York between 56 and 57⅛c. As sellers seem reluctant to make offerings at the lower level, the New York market closes steady at 56¼c.

Mexican Dollars (Old Mexican pesos): April 7th, 43¼c.; 8th, 43⅛c.; 9th, 42½c.; 11th, 43⅜c.; 12th, 43c.; 13th, 42⅝c.

Foreign Exchanges

Closing cable quotations on Tuesday, April 12, were: Francs, 3.91½c.; lire, 4.87c.; and marks, 23.70c. Canadian dollars, 3/32 per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Per lb., 98 or 99 per cent grade, price of leading interest, 26c.; outside market, 25.30@25.80c. London, 98 per cent, £105@£107 per long ton for domestic consumption.

Antimony—Per lb., duty paid, New York: Chinese brands, spot business at 12⅞@15⅛c.; May arrival about ⅛c. higher; Cookson's "C" grade, spot, 18c. Market dull. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, 16½c.

Bismuth—Per lb., New York, in ton lots, $2.20@$2.25. London, 8s.

Cadmium—Per lb., New York, 60c. London, Australian metal selling freely at 1s. 10d.

Iridium—Per oz., $115@$120 for 98 @99 per cent sponge and powder.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton, according to quantity.

Palladium—Per oz., $59@$63. Small lots bring up to $68. Pure metal as a constitutent of crude platinum, $55@ $59 per oz. London, £11@£12, nominal.

Platinum — Official price quoted by the leading interest on miscellaneous orders for refined metal, $104. Price cut from $108 on April 7. Open market cash sales of large lots, in New York, $97@$99. Pure metal as a constituent of crude platinum, $96@$97. Market remains dull.

London, £22 per oz. for refined and £18½@£19½ for crude. Dull.

Quicksilver—Per 75-lb. flask, $122@ $124. Nominal. Good demand in Europe and China. San Francisco wires $122.67. London, £20½.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of April 9.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian (washed), 53@55 per cent, 38@ 40c. Business dull. Chemical grades unchanged from quotations in the April 9 issue.

Tungsten Ore — Per unit of WO₃, N. Y.: Wolframite, $10.50@$10.75; Western scheelite, $11@$11.25. Dull; prices largely nominal.

Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores are unchanged from quotations in the April 9 issue.

Lead Ore Unchanged— Zinc Lower

Joplin Mo., April 9, 1927

Blende	
High	$46.80
Premium blende, basis 60 per cent zinc	$43.00@ 44.00
Prime Western, basis 60 per cent zinc	42.00
Fines and slimes, 60 per cent zinc	41.00@ 38.00
Average settling price, all zinc	43.10
Galena	
High	$97.60
Basis 80 per cent lead	92.50
Average settling price, all lead	95.69

Shipments for the week: Blende, 14,-297; lead, 2,522 tons. Value, all ores the week, $857,480.

The shipment this week closely balanced the purchase last week, and buyers still have more than a week's output contracted for, includng the purchase this week of 12,310 tons. Output this week was approximately 1,000 tons more than the shipment. There are listed 145 mills in operation, 30 of which are reconcentrating tailing, and of the other 105 mills 8 are on part time, 89 on day shift, and 18 on day and night shift. Production, including the product of the tailing mills, is estimated from 15,000 to 15,500 tons.

Despite an apparent weakness in pig lead, buyers held the price of lead concentrate unchanged at $92.50 per ton. Sellers are holding. The shipment this week was 700 tons less than last week.

Platteville, Wis., April 9, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$45.75
Lead Ore	
Lead, basis 80 per cent lead	$97.50

Shipments for the week: Blende, 1,163 tons; lead, none. Shipments for the year: Blende, 18,473; lead, 460 tons. Shipments for the week to separating plants, 2,118 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fullers Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the April 9 issue.

Mineral Products

Arsenious Oxide (White Arsenic)— 3¾c. per lb. Quiet.

Calcium Molybdate, Copper Sulphate, Sodium Nitrate, Sodium Sulphate (Salt Cake), and Zinc Oxide are unchanged from prices in the April 9 issue.

Ferro-Alloys

Ferromanganese—Domestic and foreign, 78@82 per cent, $100 per long ton, furnace or duty paid, for delivery during first half of 1927. Spiegeleisen, 19@21 per cent, $37, f.o.b. furnace; 16@19 per cent, $34; nominal.

Ferrotungsten—$0.98@$1.03 per lb. of W contained, f.o.b. works. Market spotty.

Ferrocerium, Ferrochrome, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferro-uranium and Ferrovanadium are unchanged from prices in the April 9 issue.

Metal Products

Rolled Copper—Sheets, 21¾c.; wire, 14⅞@15c. f.o.b. mill.

Lead Sheets—Full rolled, 11c. per lb.; clipped, 11¼c.

Nickel Silver—28¾c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 19¼c. per lb.; rods, 16¼c.

Zinc Sheets—11c. per lb., f.o.b. mill.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the April 9 issue.

Steel Steady—Pig Iron Quiet—Coke Easier

Pittsburgh, April 11, 1927

The bituminous coal strike has proved a mild affair thus far, but experienced observers realize that the crucial test is not likely to come for many weeks. Steel production will probably not be restricted, but indeed may be stimulated by freer buying of steel should the strike create fears in the minds of steel users.

Steel ingot production in March, at 4,559,400 tons, made a new record, passing the preceding March by 1.6 per cent. The quarter falls 2 per cent below the first quarter of last year. A few per cent of last month's production was represented in accumulation of ingot stocks, as an extra safeguard against the coal strike.

The Steel Corporation's unfilled obligations decreased only 43,979 tons in March, against decreases of 203,058 tons in February and 160,792 tons in January, yet there was an increase in shipments, from about 87 per cent as the average of January and February to about 95 per cent in March. Probably contracting for the second quarter was stimulated by the coal strike.

Pig Iron.—The Valley market continues quiet. Bessemer is quoted at $19.50; basic, $19; foundry, $18.50, f.o.b. Valley furnaces.

Connellsville Coke.—Thus far there has been no striking in the Connellsville region, but more or less trouble is expected before the general bituminous strike is over. The spot market shows an easier tone, with spot furnace unchanged at $3.25@$3.50 and spot foundry off 25c. to $4.25@$4.75.

Mining Stocks—Week Ended April 9, 1927

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	46⅞	46¼	46⅜	Ap.16,May21 Q	0.75
Arcadian Consol.	Boston	*50	*40	*40		
Ariz. Com'l	Boston	7	7	7	Ja. 7, Ja. 28	0.50
Calaveras	N. Y. Curb	2 3/16	2	2 3/16		
Calumet & Arizona	New York	67	66¼	66½	Ma. 5, Ma. 21 Q	1.50
Calumet & Hecla	Boston	15⅛	15⅛	15⅛	Fe.28, Ma.15 Q	0.50
Cerro de Pasco	New York	63	61⅞	62⅛	Ap. 14, My.2 Q	1.00
Chile Copper	New York	36⅞	36⅛	36½	Ma.4,Apr.1, Q	0.62½
Con. Coppermines	N. Y. Curb	3½	3	3⅛		
Copper Range	Boston	13⅛	13	13	Ap.2, My 2, A	1.00
Crystal Copper	Boston Curb	*27	*26	*26		
East Butte	Boston	2⅛	2	2	Dec., 1919	0.50
Granby Consol.	New York	36½	35½	35⅝	May, 1919	1.25
Greene-Cananea	New York	38⅛	33	36½	Nov., 1920	0.50
Hancock	Boston	...	...	*60		
Howe Sound	New York	38⅛	38	38⅛	Apr.1,Apr.15 Q	1.00
Inspiration Consl.	New York	19⅛	19	19	Ma.17, Ap.4,Q	0.25
Iron Cap	Boston Curb	2	2	2		
Isle Royale	Boston	10⅛	10⅛	10⅛	Fe.4, Fe.19 Q	0.50
Kennecott	New York	62⅛	61⅛	62⅛	Mar. 4 Apr. 1 Q	1.25
Magma Copper	New York	34⅛	33⅞	34⅛	Ma.31,Ap.15,Q	0.75
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	15⅛	15⅛	15⅛	My.2,My.16 Q	0.37½
Mohawk	Boston	39⅛	39	39⅛	Ja.29, Ma 1 Q	1.00
Mother Lode Coa	New York	4½	4⅛	4⅛	De.10, De.31SA	0.37½
Nevada Consol.	New York	14⅛	14	14⅛	Ma.17,Ma 31Q	0.37½
New Cornelia	Boston	22⅛	22⅛	22⅛	Fe.4, Fe.21 Q	0.50
Noranda	N. Y. Curb	21⅛	20⅞	21⅛		
North Butte	Boston	2⅛	1⅛	1⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*45	*42	*45	Sept., 1926	0.03
Old Dominion	Boston	15	14⅛	14⅛	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	...	...	126½	Ma.22, Apr.2 Q	1.50
Quincy	Boston	16⅛	16	16	Mar., 1926	1.00
Ray Consolidated	New York	15	14⅞	15	Ap.20, Ap.30	0.25
St. Mary's Min. Ld.	Boston	21⅛	21⅛	21⅛	Fe.10 Ma.10	2.00
Seneca Copper	New York	2⅛	1⅞	2⅛		
Shattuck-Denn	Boston Curb	4⅞	4⅞	4⅞		
Tenn. C. & C.	New York	11⅛	11	11⅛	Fe.28, Ma.15, Q	0.25
United Verde Ex.	N. Y. Curb	26	25⅛	25⅛	Apr.6, May1 Q	0.75
Utah Copper	New York	...	...	112	Ma.17,Ma.31Q	1.50
Utah Metal & T	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*54	*50	*54		
NICKEL-COPPER						
Internat. Nickel	New York	47⅛	41⅛	46⅛	Ma.17,Ma.31Q	0.50
Internat. Nickel, pfd.	New York	...	...	105	Ap.14,My.2 Q	1.50
LEAD						
Gladstone Mtn.	Spokane	*28	*24	*25½	March, 1927 Q	0.005
National Lead	New York	195	191	191	Ma.11,Ma 31Q	2.00
National Lead pfd	New York	126½	125	126	March, 1927 Q	1.75
St. Joseph Lead	New York	41⅛	40⅛	40½	Jn.10,Jn.20, QX	0.75
ZINC						
Am. Z. L. & S.	New York	9⅛	8⅛	9	May, 1917	1.00
Am. Z. L. & S, pfd.	New York	50⅛	48⅛	48⅛	Nov., 1920	1.50
Butte C. & Z.	New York	4	3⅛	3⅛	De.9, De.24	0.50
Butte & Superior	New York	9⅛	7⅞	9	Ma.15, Ma.31Q	0.50
Callahan Zn-Ld	New York	1⅞	1⅛	1⅛	Dec., 1920	0.50
Consol. Lead&Zinc'A'	St. Louis	14⅛	13⅛	13⅛	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	28⅛	27⅛	28	Fe.15, Ma.1 Q	0.40
Eagle-Picher, pfd.	Cincinnati	...	...	100	De.31, Ja.15 Q	1.50
New Jersey Zn.	N. Y. Curb	193⅛	186	190	Ja.20, Fe.10 Q	2.00
United Zinc	N. Y. Curb	...	...	55		
Yellow Pine	Los Angeles	*25	*25	*25	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Argonaut	Toronto	*43	*37½	*43		
Barry-Hollinger	Toronto	*44½	*36	*42½		
Carson Hill	Boston	...	...	*50		
Consol. W. Dome L.	Toronto	*7¼	*7⅛	*7⅛		
Cresson Consol. G.	N. Y. Curb	2⅞	2⅛	2⅞	Ma.31,Ap.10 Q	0.10
Dome Mines	New York	9	8⅛	8½	Ap.18, My5 Q	0.25
Golden Cycle	Colo. Springs	†1.71	†1.69	...	Fe.28,Ma.10 Q	0.04
Hollinger Consol.	Toronto	20.95	20.75	20.80	Ap.6, Ap.20	0.10
Homestake Mining	New York	62½	62	62	Ap.20,Ap.25 M	0.50
Kirkland Lake	Toronto	1.09	*87	1.07		
Lake Shore	Toronto	18.75	18.00	18.55	Ma.1, Ma.15	0.10
McIntyre-Porcupine	New York	24⅞	24⅛	24⅛	Fe.1, Ma.1 Q	0.25
Portland	Colo Springs	†*50	†*49½	...	Ap.6, Ap.15, Q	0.02
Rand Mines	New York	....	....	9⅛	Au.23–30Am.Sh	1.52
Teck-Hughes	Toronto	6.95	6.52	6.82	Ja.31, Fe. 1	0.05
Tom Reed	Los Angeles	*52	*50	*52	Dec., 1926	0.02
Tough-Oakes	Toronto	*54½	*43	*53		
United Eastern	N. Y. Curb	*44	*43	*44	July, 1924	0.05
Vipond Cons.	Toronto	1.46	1.40	1.46	Apr.1 Apr.15	0.03
Wright-Hargreaves	Toronto	10.65	10.52	10.60	Ap.15,My.2	0.10
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	*13	*12½	*13		
Con. Cortez	N. Y. Curb	*24	*20	*24		
Con. Virginia	San Francisco	*4½	*4½	*4½		
Dolores Esperanza	N. Y. Curb	...	...	*35	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅛	2 3/16	2 3/16	Ma.15, Ap.4Q	0.08
Tonopah Belmont	N. Y. Curb	2	1⅞	2	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	...	...	*32	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	2⅛	2	2	Ma.31, Apr.21	0.07½
West End Consol.	N. Y. Curb	*12	*10	*12	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*45	June, 1918	0.02
SILVER						
Beaver Consol.	Toronto	*80½	*63	*76½	May. 1926	0.03
Canadian Lorrain	Toronto	*39¼	*35	*36½		
Castle-Trethewey	Toronto	1.06	*96	1.00		
Coniagas	Toronto	3.85	3.41	3.75	May. 1924	0.12½
Keeley	Toronto	1.46	1.40	1.43	Fe 28, Ma.15 X	0.12
Lorrain Trout Lake	Toronto	....	....	*35	July, 1925	0.05
McKinley-Dar.-Sav.	Toronto	*13½	*13	*13½	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.65	3.20	3.53	De.30, Ja.15	0.12½
Nipissing	N. Y. Curb	7⅛	7⅛	7⅛	Ma.31, Ap.20 Q	0.15
SILVER-LEAD						
Ahumada	New York	4⅛	4⅛	4⅛	Ma 25,Ap 4,Q X	0.12½
Bingham Mines	Boston	41⅛	41⅛	41⅛	Ma.21, Ap.5 Q	1.00
Bunker Hill&Sullivan	N. Y. Curb	74⅛	74	74⅛	Ma.31,Ap.4MX	0.50
Cardiff M. & M.	Salt Lake	...	...	*38	Feb. 5, 1927	0.10
Chief Consol.	Salt Lake	2.65	2.50	2.60	Oc.10, No.1 Q	0.10
Consti'n Mng.&Mill'g	Spokane	*33	*30	*33		
Erupcion	Boston Curb	*75	*65	*65	Ma.25, Ap.2 Q	0.07½
Eureka Lily	Salt Lake	1.37½	1.22½	1.37½		
Federal M. & S.	New York	112	112	112		
Federal M. & S., pfd.	New York	95⅛	92⅛	95⅛	Fe.24, Ma.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*5	*4	*5		
Hecla Mining	N. Y. Curb	14⅛	14⅛	14⅛	Fe.15,Ma.15 Q	0.25
Highland-Surprise	Spokane	*10½	*9	*9		
Iron King Mining	Salt Lake	*43	*37	*40		
Keystone Mining	Salt Lake	*32	*32	*32	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*20½	*19	*19½		
Lucky Tiger-Com.	Kansas City	†7.15	†6.62½	....	Ap.20, 1927 M	0.05
Mammoth Mining	Salt Lake	...	...	2.00	De.17, De.23,Q	0.25
Marsh Mines	Spokane	2⅛	2⅛	2⅛		
North Lily	Salt Lake	2.90	2.50	2.90		
Park Utah	New York	7	6⅛	7	Ma.15, Ap.1 Q	0.20
Plutus Mining	Salt Lake	...	...	2.00	Ja.10, Ja.15 Q	0.10
San Rafael	San Francisco	...	...	*24		
Silver King Coal	Salt Lake	7.60	7.55	7.55	Ma.21, Ap.1 Q	0.25
Silversmith	Spokane	*33¼	*28	*33⅛	Oc.1, Oc.10 Q	0.02
Strattons Mines	Spokane	*45	*43⅛	*45		
Sunshine M. Co.	Spokane	*56⅛	*52	*55		
Tamarack-Custer	Spokane	*32	*30	*31⅛	Sept., 1924	0.25
Tintic Standard	Salt Lake	10.75	10.62½	10.75	Ma.16, Ma.29X	0.40
Utah-Apex	Boston	6⅛	5⅛	5⅛	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	56⅛	52⅞	55⅛	July, 1924	1.25
Butler Bros	Chicago	23½	22	22⅛	Ja. 29, Fe. 15 Q	0.625
Cleveland-Cliffs Iron	Cleveland	80	77	77	Ja.15, Ja.25 Q	1.00
Colorado Fuel & Iron	New York	76⅜	66⅛	72⅛	May, 1921	0.75
Gt. North'n Iron Ore	New York	21⅛	20⅛	20⅜	Dec.6, Dec.28	0.75
Inland Steel	New York	43	42⅛	43	Fe.15, Ma.1 Q	0.62½
Replogle Steel	New York	10⅞	10	10⅛		
Republic I. & S.	New York	72⅞	69⅜	71⅛	Fe.15,Ma.1 Q	1.0
Republic I. & S. pfd.	New York	104⅛	104	104	Ma.15, Ap.1 Q	1.75
Sloss-Sheffield S. & I.	New York	134⅛	130	131½	Ma.10, Ma.21 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	107	107	107	Ma 21, Ap.1 Q	1.75
U. S. Steel	New York	172⅛	169	171	Fe.28,Ma.30 Q	1.75
U. S. Steel pfd	New York	133	132	132	Ja.29, Fe.26,Q	1.75
Virginia I. C. & C.	New York	...	...	44	Jan., 1924	1.50
Virginia I.C.&C.pfd.	New York	...	...	60⅛	De.15. Ja.2,	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York	...	...	30⅛	Ja.26, Ja.29	1.45
So. Am. Gold & P.	N. Y. Curb	3⅛	3⅛	3⅛		
Alum.Co.of Amer.	N.Y.Curb	68	68	68		
Alum. Co. of Amerpf.	N.Y.Curb	104	104	104	Ma.15,Ap.1 Q	1.50
Vanadium Corp.	New York	52	50	50⅞	Fe.1, Fe.15, Q	0.75
Patino M. & E.	New York	23⅛	21⅛	23⅛	Ma.10, Ma.15	4sh.
ASBESTOS						
Asbestos Corp.	Montreal	24	22⅛	22⅛	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal	87⅛	87	87⅛	Ma.31,Ap.15 Q	1.75
SULPHUR						
Freeport Texas	New York	74⅛	58⅛	74⅛	Ap.15, Ma.2 Q	1.00
Texas Gulf, new	New York	65⅛	59⅛	64⅛	Ma.1, Ma.15Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	42⅜	42	42	Fe.18. Ma. 1 Q	0.75
Amer. Metal pfd.	New York	....	....	110⅛	Fe.19, Ma.1 Q	1.75
Amer. Sm. & Ref.	New York	148⅛	143	148⅛	Ap.14, My.2 Q	2.00
Amer. Sm.&Ref.pfd.	New York	122	121⅛	121⅛	My.6, Jn.1 Q	1.75
Consol. M. & S.	Montreal	264	258⅛	260	De.31, Ja.15 X	6.25
Federated Metals	N. Y. Curb	...	...	13		
Newmont Mining	N. Y. Curb	...	...	77⅜	Ma.31,Ap.15 Q	0.60
U. S. Sm. R. & M.	New York	38⅛	36⅜	36⅛	Ap.7 Ap.15 Q	0.87½
U. S. Sm. R.&M.pfd.	New York	49	47⅛	47⅛	Ap.7, Ap.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED MARCH 29, 1927

Name	High	Low	Last		Last Div. Date	Amount
Aramayo Mines (25 frs.)	85/7½	84/4½	85/-	Feb. 1927	5 (†)	
British Platinum (£1)	4/6	3/—	4/—	Feb. 1925	2½ p.c.	
Burma Corpn. (10 rupees)	14/3	13/9	14/—	Feb. 1927	6 annas*	
Bwana M'Kubwa (5s)	6/6	6/3	6/4½			
Camp Bird (2s)	5/—	4/6	5/—			
El Oro (£1)	4/6	4/1½	4/4½	Nov. 1924	2½ p.c.*	
Esperanza (10s)	—/2	—/2	— 2			
Frontino & Bolivia (£1)	13/1½	11/10½	12/6	Jan. 1927	5 p.c.	
Mexican Corpn. (£1)	9/6	9/—	9/6			
Mexico Mines of El Oro (£1)	16/3	15/1½	16/3	Dec. 1926	3½ p.c.*	
N'Changa Copper Mining	13/6	12/—	12/—			
Oroville Dredging (€1)	7/—	6/7½	6/9	Dec. 1923	3½ p.c.	
Ouro Preto (£1)	2/1½	2/—	2/—	May 1925	2½ p.c.	
Rhodesian Congo Border (£1)	63/9	61/3	62/6			
St. John del Rey (£1)	13/—	12/4½	12/6	May 1927	3½ p.c.	
San Francisco Mines (10s)	30/6	30/—	30/3	Jan. 1927	25s.	
Santa Gertrudis (£1)	15/6	15/—	15/3	Jan. 1927	3½ p.c.	
Selukwe (2s. 6d.)	10/7½	9/1½	10/6	April 1917	6¼ p.c.	
S. Amer. Copper (2s.)	3/6	3/—	3/3	Nov. 1917	75 p.c.	
Tanganyika (£1)	63/9	47/9	51/10½	Aug. 1926	7½ p.c.	
Tomboy (£1)	3/6	3/3	3/3	July 1926	10 p.c.	
Union Miniere du Haut-Katanga (Brussels)	9.300	8.750	9.300	July 1926	175 (‡)	

* Free of British income tax. † Swiss frs. ‡ Belgian frs. and free of taxation.